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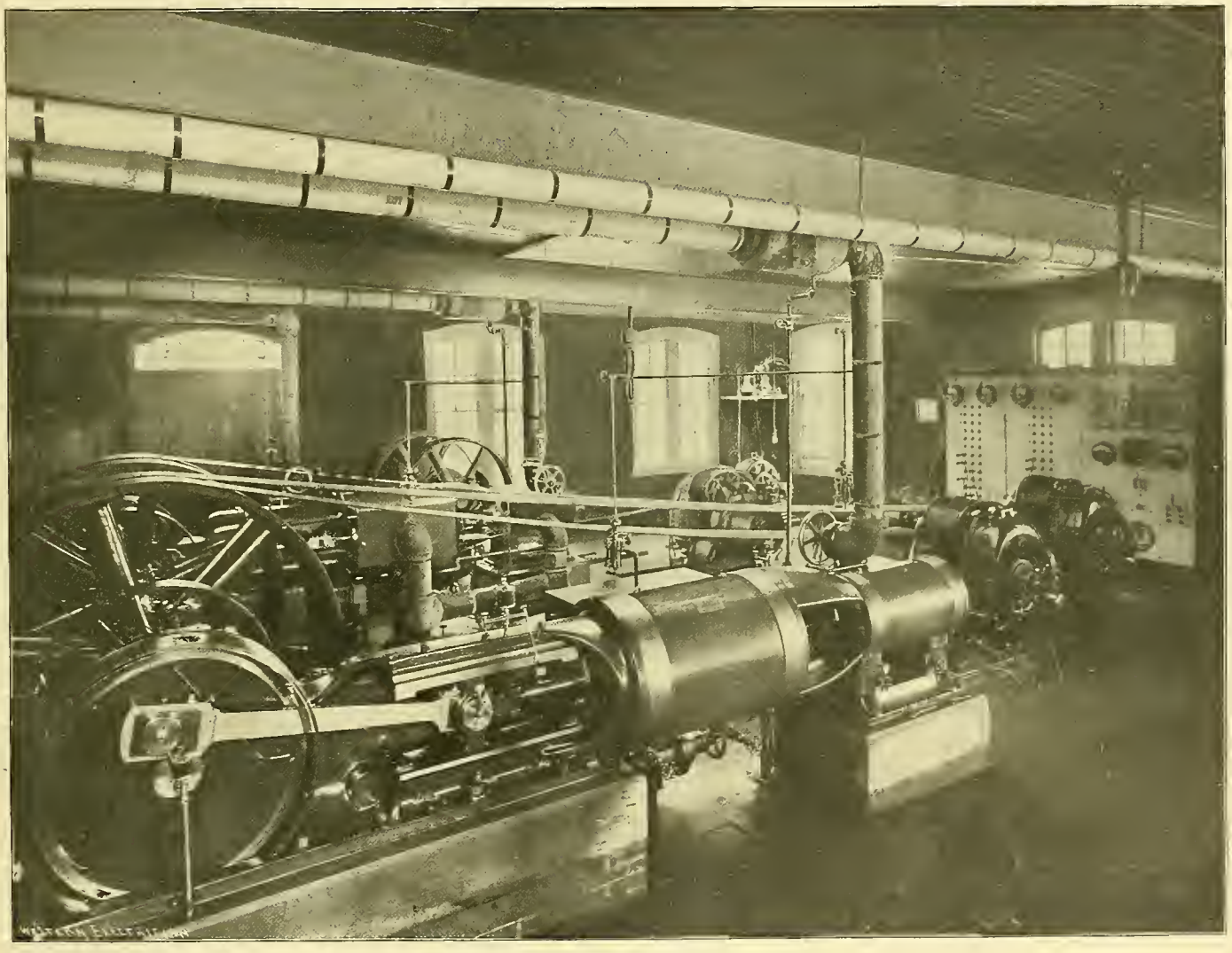
Lincoln Park Lighting.

Within the last few months a very great improvement has been made in the lighting arrangements for Lincoln Park, Chicago. This is one of the most popular parks in the city, but although arc lighting has obtained there for the last 14 years the service was insufficient for general illumination, barely sufficing for police lighting at night, and the line construction was not of a character to add to the beauty of the park. Now the power house has been enlarged, the old machines replaced by new ones, overhead poles and wires have given way to underground cables and conduits, and there are 243 arc lamps for outside lighting in place of 45.



LINCOLN PARK LIGHTING.—ENGINE AND DYNAMO PLANT.

In the general exterior view of the power house given on page two, the lower portion is the new part. The building is but a short distance from the animal house and 700 feet from Lake Michigan. It shelters the pumping plant for the water-works system of the park as well as the electric light equipment. The pumps have a total capacity of 6,500,000 gallons in 24 hours, the suction pipe being 20 inches in diameter and the distributing mains ranging from four to 16 inches.

The boilers, illustrated by the picture on the third page, are not of sufficient capacity to run both the electric and water-works plants together, but as there is little likelihood that the heavy demands for water and light will ever come at the same time, the steam requirements do not conflict. There are three tubular boilers, made by Fraser & Chalmers of Chicago. Each is five feet in diameter and 18 feet long and rated at 100 horse power. The stack, which is of brick, is but 80 feet high and does not furnish sufficient draught to the furnaces. The deficiency is made up by an outfit for forced draught consisting of an overhead Sturtevant blower driven by belt from an upright 10 horse power New York Safety engine on the floor beneath. The piping from this blower to the furnace fronts is plainly shown in the picture and also the Jagoda steam stokers by which the bituminous screenings used for fuel is fed onto the grate-bars. The coal is dumped into the hopper with which each stoker is provided, and is forced into the furnaces as required by the plunger action of the piston of a steam cylinder, controlled by a lever at the side. By this means the fresh coal is forced under the burning mass on the grate, and the advantage is claimed that the gases are consumed before rising to the top and passing off.

A view of the electrical plant is given on this page. The installation consists of two Buckeye tandem compound condensing engines of 160 horse power each belted to three Excelsior 80-light arc dynamos and one Ideal simple engine of 100 horse power driving a Westinghouse multipolar alternator of 1,000 lights capacity for the incandescent service. One of the Buckeye engines drives two arc machines, while the other is at present connected to only one. This latter dynamo will probably be replaced, however, by a machine having a capacity of 150 lights. There is an independent Worthington condenser outfit for the larger engines. During the summer, when there is scarcely any demand for incandescent light, the Ideal engine will operate two Brush arc dynamos having a capacity of 20 amperes at 2,000 volts each, which will supply current to the 16 projector lamps in the electric fountain. These Brush machines are the ones that have heretofore supplied light to the fountain, but they have not yet been placed on their foundations in the new plant. The small exciter for the alternator, placed on a shelf above the latter and driven by belt connection from its shaft, completes the list of dynamos. It may be mentioned that the old arc dynamo used for lighting the park was a Fuller-Wood hand-regulating machine that had been running 14 years.

A handsome white marble switchboard with polished black slate trimmings provides for six arc circuits—two from each Excelsior dynamo—and plug connections are provided for six additional circuits, as extensions are made. The measuring instruments are of the Weston and Westinghouse types. On the portion of the board devoted to the alternator there is the usual outfit of knife switches and instruments, including a ground detector. The face of the field rheostat is sunk into the marble, so that the contact-arm does not project beyond the surface.

All cables of the distributing system are underground,

laid in iron conduit. The primary circuits for the incandescent service are operated at 2,000 volts and Simplex wire is used. Westinghouse transformers reduce this pressure to 100 volts for the secondary circuits in the Academy of Sciences, refectory and all other buildings where the incandescent light is used. Distributed about the park and some of the adjacent boulevards are 243 arc lamps, made by the Excelsior Electric company. They are of the single-carbon, series pattern, of 2,000 nominal candle power each. They will burn 14 hours without re-trimming and are supported on the familiar World's Fair iron posts, a sufficient number of which were purchased by the Lincoln Park commissioners. Patterson paper-insulated cable supplied by the Western Electric company is used for the arc circuits. In all there is about 21 miles of underground cable in the park. The arc lamps are burned from sunset until midnight, and all repairs are made at the power house.

The electric light equipment of Lincoln Park is in charge of H. C. Alexander, superintendent; A. A. Babcock, civil engineer, and D. W. Fuller, engineer in charge of plant.

Unreasonable Use of Water Power.

A question of liability for damages unlike anything of the kind which ever came before a New Hampshire court, and one which attracted unusual interest on account of the influence of its decision in some pending cases, was recently decided in Grafton county.

An electric light plant was built on the Mascoma, a

LINCOLN PARK LIGHTING.—THE POWER HOUSE.

tributary of the Connecticut River, to furnish lights for Dartmouth College and for adjoining towns. The company built a dam which held back the water for use at night. The complainant owned a mill just below the electric light plant, which he alleged he could run only at night, when the electric light plant was running.

The finding of the court is as follows: "That the use of water by the Mascoma Electric Light & Gas company is not reasonable, and the manner in which it shall be used and regulated will be determined later. A conference of all parties in interest will be held as soon as arrangements can be made for such a meeting." The lawyers on the case have been unable to find any decision covering a case similar to this in any of the law reports, and the finding of the court has been awaited with interest by those having any knowledge of the points at issue. The decision means that in New Hampshire an electric light plant cannot prevent the natural flow of a river to the injury of others below it on the same stream, by holding back the water of the river to be used in running machinery at night.

Strike on the West End Road.

Boston experienced the vicissitudes of a street railway strike on Thursday of last week. The trouble only lasted 24 hours, as the men were poorly organized and lacking in leadership. On Christmas day most of them went back to work, although it is said that about 700 of the old men were refused regular positions. The men were greatly crestfallen at the failure of their attempt to better themselves, and there is danger of future agitation.

The Theory of the Wiring Table.

By Thomas G. Grier.

Wires are used to form an easy and direct path for the distribution of the electric current, as pipes are used for distributing gas or water to places at a distance from the source of supply. The sizes of pipes are determined upon the basis of the distance and the quantity of material sent through them. Wires, as well, must have some distinct size, depending upon the circumstances governing different conditions. It is necessary to make calculations in order to ascertain the size of wire, and to shorten and to simplify this work of calculation wiring tables have been compiled.

A wiring table gives at once the result in the commercial size of wire, and when the proper table is at hand no multiplying or dividing, no figuring, no appplication of a formula is required.

In all substances there exists some unknown obstruction to the flow of an electric current. The technical name given to this obstruction to the passage of an electric current is resistance. It is not known what causes this resistance, but by experiment the extent to which it exists in any substance can be ascertained and measured. It is known how in any substance the amount of resistance may be varied by altering the dimensions, also as to the amount of energy necessary to overcome any resistance. The theory of the wiring table is simply one of proportioning resistances.

The first point to be considered is: How is the resistance varied in any substance? The law states that the resistance of any substance varies directly as its length and inversely as its cross-section. This law has been verified by experiment and is universally accepted as a law of nature. To say that the resistance varies directly as the length of any given substance means that if the length of a wire is doubled the resistance is doubled, and three times the length means three times as much resistance; while the statement that the resistance varies inversely as the area of cross-section means that if the area of a wire is doubled—that is, if there is just twice as much metal for a given length of wire—the resistance is decreased one-half. If the area is increased three times, the resistance is decreased to one-third. In a wire of a given substance if the length is doubled, and, at the same time, the area is doubled, the resistance remains the same, or if the length is increased three times, and, at the same time, the area is increased three times, the resistance remains the same.

From this application of the law already referred to, it can be seen how it is possible to vary the size of a wire so that the resistance remains constant for any length, or how the resistance may be changed to suit any condition or circumstance.

The next consideration is the action of the electric current. The pressure is measured in volts and the rate of flow is measured in amperes. The volts are all used up in forcing the amperes against the resistance. The resistance (if it were all in the wire) would mean a total loss of the electrical energy, because the volts would be used in doing work from which no results were obtained. It is necessary, therefore, to make the resistance of the wire which conducts the current but a proportion of the total resistance, the rest of the resistance of a circuit being that which exists in the lamps and the other devices or apparatus which converts the electrical energy into commercial forms, as light, power or heat.

To so compile a table and calculate the sizes it is necessary to consider the relation which exists between the unit of resistance, the ohm, the unit of pressure, the volt, and the unit of current, the ampere.

One ohm resistance requires the pressure of one volt to transmit one ampere. Two ohms requires two volts to transmit one ampere. One volt will transmit but one-half an ampere over two ohms, and 100 volts will transmit 10 amperes over 10 ohms. This is Ohm's law, which, when given in the form usually found in text-books, is as follows: The rate of flow or current, measured in amperes, is equal to the volts divided by the ohms. The volts are equal to the amperes multiplied by the ohms, and the ohms are equal to the volts divided by the current flow or amperes.

Knowing the relation of resistance to the flow of currents and the pressure, the next point to be considered is the substance used for the wires, and to ascertain the amount of its resistance for a given length and size, to be used as a unit for making the calculation necessary in compiling the table.

Copper, commercially and physically, represents the best conductor for the transmission of the electric current. A dollar's worth of copper will conduct a greater amount of electric current than any other metal of equal value with the same loss of energy. In the illustrations following, copper will be the substance considered, as the wiring tables used for ascertaining the size of wire are for copper wire.

The units by which wire is measured are the circular mil and the foot. The circular mil is the area of a circle whose diameter is .001 of an inch. The foot is a unit familiar to all. The unit of wire, then, would be a wire one foot long, the area of which is one circular mil, and the resistance of this unit of copper wire is between 10 ohms and 11 ohms, depending upon the temperature of the wire; 10.6 approximates closely to the average at ordinary temperatures. Taking this as the basis for compiling a wiring table, it is known that to send an ampere through this unit of wire would require 10.6 volts. For, as stated in Ohm's law, the volts must equal the ohms multiplied by the amperes.

But in everyday problems the known quantities are the volts and amperes, and the calculation is to find wires of proper resistance to suit the conditions. The resistance, or the ohms, must equal the volts divided by the amperes. To solve this problem, the volts are divided by the amperes and we have the resistance.

The resistance varies as the length and inversely as the area. It is the area of a wire which is desired, and one the resistance of which will equal the resistance found by dividing the volts by the amperes. The resistance of one foot of copper wire one circular mil in area equals 10.6 ohms. The resistance of any wire is equal to its length multiplied by 10.6 and this divided by the area. Now it is known that the volts divided by the amperes equals the resistance, and the volts divided by the amperes are, therefore, equal to the length of the wire multiplied by 10.6 and divided by the area.

In any problem of wiring we have the number of volts and amperes, also the distance the current is to be transmitted, and the only thing remaining to be found is the area. To find this, we multiply 10.6 by twice the distance or the total length of wire (in multiple arc work there is an outgoing wire and the return circuit, which makes a total length of wire double the distance), and multiply this by the amperes, and divide the product by the volts used, which gives the area of the wire. The volts used are not the total volts of the system, but the volts lost in the wire. If the problem is stated as so many per cent. loss, it would mean a percentage of the total number of volts. To illustrate—if the wire is to use up two per cent. of the pressure, and the voltage of the system was 50, then you would divide by two per cent. of 50 or one volt, or if the pressure was 100 volts you would divide by two per cent. of 100 or two.

In compiling a table let it be assumed to be for a 50 volt system for a regular increase of distances of 10 feet. The following method is pursued: First, the per cent. loss is ascertained; let it be two per cent. This then would be one volt. Then one ampere will be considered first as the total current flow, and the following calculations would be made: 10.6 would be multiplied by 10 feet and by two to get the length of the wire, and this multiplied by one ampere and the product divided by

volts lost, or, in this case, by one, which would give us an area of 212 circular mils. This would be the size of a wire necessary to allow one ampere to be transmitted 10 feet with one volt loss (or two per cent. of 50 volts).

The next calculation would be for 20 feet distance, and as the resistance of the wire must remain the same, the area first found, namely 212 circular mils, must be doubled, as the distance has been doubled. For 30 feet, to keep the resistance constant, the area is increased three times, and so on until the limit of the table, say 200 feet, is reached, when the area will be increased 20 times, as the length has been increased by that amount.

Then the same method will be continued for two amperes, namely, multiplying 10.6 by the distance and by two to get the length of wire, and this multiplied by the amperes, and the whole divided by the volts lost. This is continued until the area for all the wires for each of the distances and for the various number of amperes have been determined.

As it is necessary to multiply 10.6 by the distance multiplied by two in every instance, 21.2 is used instead, and the straight distance used. The whole resolves itself into the simple formula:

$$\frac{21.2 \times \text{distance} \times \text{amperes}}{\text{Divided by volts lost}} = \text{area of wire.}$$

When these areas are found, the commercial sizes of wire are inserted in the table, which are nearest to the size found, but always larger, never smaller; that is, if the area found in the calculation came between a 0 wire and a 00 wire, the 00 wire would be the size used in the table.

Consolidation of the Commercial Cable and Postal Telegraph Companies Effected.

The consolidation of the Commercial Cable and Postal Telegraph-cable companies was effected at stockholders' meetings held in New York on December 22d. The details of the absorption of the Postal by the Commercial company, as planned by the directors and announced in the WESTERN ELECTRICIAN of December 12th, were carried out. Further particulars of the transaction are given as follows:

The amalgamation between the Cable and Postal companies is chiefly one of financial administration, and the use of the Postal company's name and the management of the company's affairs will remain as at present.

It is interesting to note that in 1887 the entire number of messages transmitted by the Western Union was 12,400,000, which was about the same number as was handled by the Postal in 1895, while in 1895 the two companies together handled more than 70,000,000.

One hears a great deal about the inroads that have been made by the telephone, but the telegraph earnings of the Western Union and Postal companies do not seem to have suffered very much in consequence. Looking back during the last three or four years at the great shrinkage that there has been in the earnings of railroads and other corporations, one cannot but be surprised that the telegraph companies have not only held their own, but have shown some progress.

Within the next 12 months or so a Pacific cable is likely to be laid from San Francisco to Japan, and another one from Vancouver to Australia. These cables will divert to the Atlantic cables and to the American land line telegraphs a large traffic which now finds its way to the far East over other routes. It is claimed by the promoters of the Pacific cable that the United States and Canada form the most natural and most expeditious route between Great Britain and the far East.

There is invested to-day in the Atlantic cables alone, owned by private companies (outside of the Commercial and French companies), some $56,000,000. Of this sum there is invested in the "pool" companies, which are in competition with the Commercial, as follows: Anglo company, $35,000,000; Direct United States company, $7,000,000; American Cable company, $14,000,000; an aggregate of $56,000,000, which, with the Commercial company's capital of $10,000,000 and the French company's of $4,800,000, makes a total of $70,800,000.

In the land line business, the Western Union has a capital of $95,370,000, and bonded indebtedness of $14,813,514, a total of $110,183,514, which, with the Postal company's capital of $15,000,000, makes a grand total of $125,183,514 invested in the land line business of the United States. In addition to this are numerous small sub-companies, which would swell this amount by several millions.

Cable stock is practically unknown in America as an investment, its chief center being London, where there is invested in corporations owned by private companies, exclusive of what is under the control of the different governments, the sum of £35,800,000. In the early stage of the cable business the investor looked with a great deal of suspicion upon cable stock. At that time the life of a cable was estimated to be about 10 years. Later on this was increased to 25 years, and now the best scientific opinion believes that there is no reason why a cable should not last forever. The stocks of the leading cable companies in England sell at nearly as high a price as the best class of English railroads. Great Northern Cable, which pays 10 per cent., sells at from 240 to 250. Eastern Cable, paying 6½ per cent., sells at 170 to 175, and its four per cent. debenture stock is quoted at 126 to 129.

Under the new arrangement, with a capital of $10,000,000 and the control of the Postal company at a low rate of interest (four per cent.), and with the provision made to secure what money the Postal company requires to extend the system during the next eight or 10 years, the Commercial company is in a position to greatly improve and strengthen its system. The Commercial company has assets and plant of $15,000,000, against its capital of $10,000,000, and the Postal $18,344,145, against its capital of $15,000,000, showing a joint surplus of $8,344,145 beyond their combined capitals.

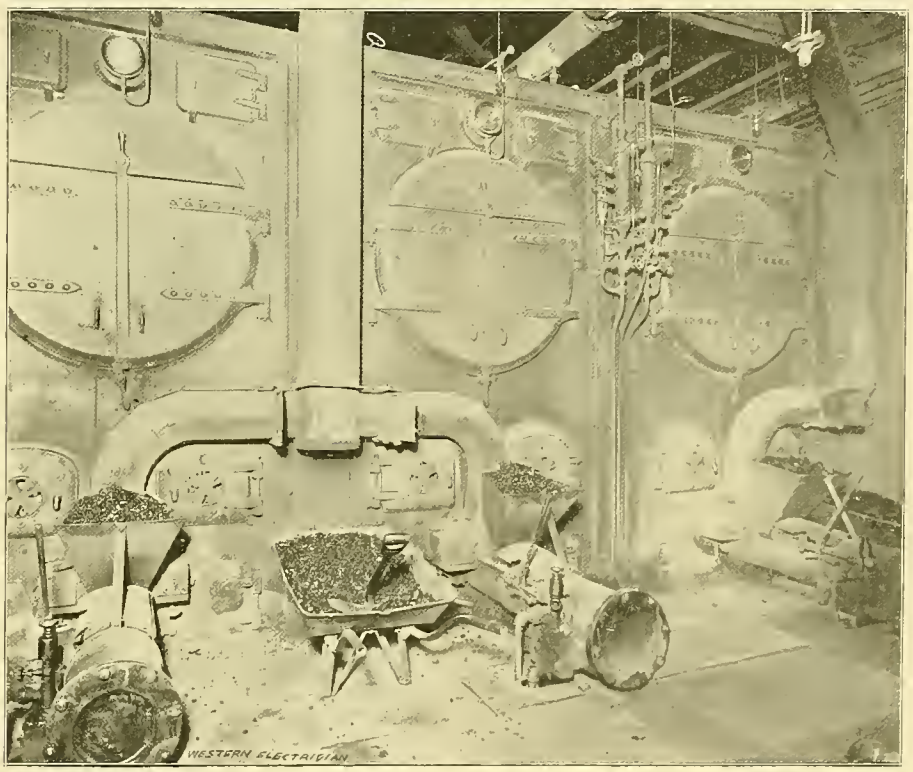
Electric Railways in the United Kingdom.

At present the electric tramways and railways [in Great Britain and Ireland] aggregate a track length of 173.25 miles, and the *Railway World* of London thinks that the list is noticeable chiefly as a record of pioneer undertakings, which form, however, a reasonable ground for the belief, now generally shared by railway men, that the country is on the eve of a rapid development of electric traction. Without exception, each of the undertakings enumerated is proving a success. Especially is this true of the later installations at Walsall, Coventry, the Hartlepools, Bristol and Dublin. These are all worked under ordinary conditions of street traffic, and the experience acquired proves conclusively that there is no reason why electric traction, as soon as the public see the facts as they actually are, should not prove as great a boon in Britain as it is in America. "We do not, of course," says our contemporary, "look for any such extraordinary extension of tramway facilities here as has been effected there; the conditions of the two countries are too diverse to permit anything of the kind, but we do anticipate a steady and increasing growth in our tramway system. There are already under consideration enough important tramway schemes to confirm this view, and these plans are not merely 'floating about' in a nebulous condition, as a contemporary recently described them, but many of them are so far advanced that their completion awaits only certain legal formalities, or the acquisition of the necessary parliamentary powers.

"It would be idle to deny that the necessity of employing the overhead trolley wire in the vast majority of cases where electric traction can be adopted will not seriously retard the progress that might be anticipated if some other method of applying electricity was generally feasible. At the same time the overhead wire is by no means regarded so unfavorably as it was some years ago. The use of the side and center poles, with their ornamental brackets, has relieved the trolley wire of much of the odium that it has had hitherto to bear, and it is now generally admitted by those who have given any serious and candid thought to the question of local transportation that with construction like that at Bristol, for instance, the obvious advantages of electric traction far outweigh the very slight annoyance that may be occasioned by the overhead wire. The visits of local officials and tramway managers to Continental cities where electric traction is now in use has done much to alter public opinion on the subject, and the opposition to the trolley wire is destined to grow 'beautifully less' as new lines are constructed, and appreciation of the benefits of modern tramway facilities increases."

Financial Affairs of the Calumet Electric Company.

Public attention has been directed toward the relation of the Calumet Electric Street Railway company and the National Bank of Illinois by the suspension of the latter. It was discovered that the bank had made loans to the railway company aggregating $2,475,000. Carl Moll, cashier of the bank, is a director of the street railway company. Within the last six months the corporation has made extensions and improvements in which, it is represented, over $500,000 was expended. The burden of financing the enterprise fell on the bank. In discussing the bank's affairs with the Clearing House committee, the officers of the bank stated that within 90 days at least $2,000,000 could be realized on the Calumet Electric Railway collateral held as security, as negotiations were pending for the sale of the road to prominent eastern financial interests. Other hopes were open to the officers of the bank. They believed that the reorganization committee of the Alley "L" would be willing to pay a good price for the Calumet property, and it was said that negotiations for a sale in that quarter were about to be opened. The Chicago City Railway company and the Englewood & Chicago company were also regarded as possible purchasers, and the risk of the extraordinarily heavy loan was taken with the confidence of large profit. John Farson is president of the Calumet Electric Railway company. He says that the road will not be seriously affected by the failure of the bank. The company operates over 75 miles of track in the southern part of Chicago, and is considered to own a good property, with fine prospects of future growth.



LINCOLN PARK LIGHTING.—BOILER PLANT.

Northwestern Electrical Association.

George Cutter has been appointed master of transportation to take charge of the Chicago delegation to the Milwaukee convention of the Northwestern Electrical association, to be held on January 20th and 21st at the Hotel Pfister. A large attendance from this city is earnestly desired. It is expected that the Chicago delegates will be able to secure a special car on the 8:30 A. M. train on the Chicago & Northwestern road on Wednesday morning, January 20th. All delegates expecting to go in this car are requested to communicate with Mr. Cutter (851 Rookery building) at as early a date as possible.

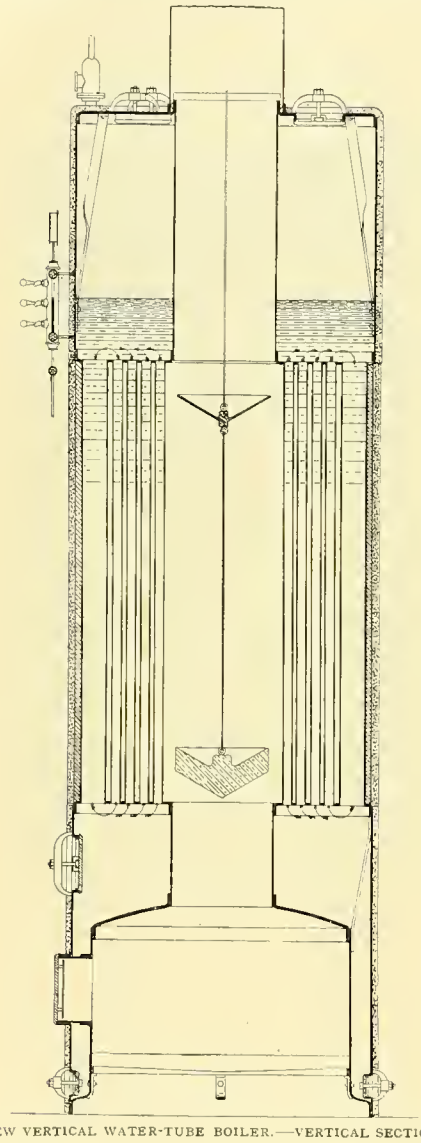
James C. Wilson has made a proposition to furnish electric lights for Elroy, Wis.

New Vertical Water-tube Boiler.

For many years the steam engineering profession has grappled with the problem of designing a steam generator that, while embodying in its construction all essential requirements of safety and economy, would at the same time recommend itself to the steam user by its low first cost. Although there are a number of first-class water-tube boilers on the market to-day, yet William C. Stuckel of Chicago thinks that not one of them can compare, in point of simplicity of construction, economy in coal consumption, ease of access to all parts of the interior of the boiler and cheapness of construction, with the "Perfection" water-tube boiler which he has invented.

The claims of superiority are said to be based upon the well-known requirements of a perfect steam generator, as laid down by the late George H. Babcock, for 50 years one of the most thorough students of steam boiler construction. The following description is given:

A lower water drum is connected with an upper steam



NEW VERTICAL WATER-TUBE BOILER.—VERTICAL SECTION.

drum by means of a number of small boiler tubes carefully expanded into two flue heads of sufficient number to give a total heating surface of ample area in conformity with the rated horse power of the boiler, based on the established rule of 10 square feet of heating surface per horse power. The lower drum encloses a firebox connected with the outside shell at its base by an annular ring or by flanging the lower end of the firebox shell outwardly, thus being joined to outside shell. The crown sheet of the firebox is connected with the lower tube sheet by a cylindrical smoke-flue of proper diameter to allow the hot gases to pass from the firebox up to the tubes. A short distance above the upper end of this smoke-flue, suspended from above, is a circular deflecting plate cone-shaped and made of fire clay, by means of which the hot gases are deflected sideways and forced to pass between and around the small tubes, thus imparting their heat units to the water contained inside the tubes, and encircling in their upward movement the water tubes, until the gases reach the top flue sheet, and pass to the outside through a second smoke-flue, of the same diameter as the lower one. The upper smoke-flue connecting the flue head and upper heads of the steam drum acts also as a super heater of steam.

In order to compel the gases to surround the water-tubes as long as possible, two cast-iron deflectors are employed and suspended by rods from lugs attached to the inner side of the top smoke-flue. The upper deflecting plate holds in suspension the lower deflecting plate. The top head of the upper drum is provided with a number of manholes for the easy access to the inside of the top drum, and affording at the same time a ready means of removing and replacing any defective tubes. The lower drum is also provided with one manhole and four handholes near the bottom, the latter for the purpose of washing out all accumulations of impurities contained in the water and deposited in the bottom of the water leg.

The small tubes, which are placed in circular rows, leaving a clear open space in the center of the boiler somewhat larger in diameter than the smoke-flue, are surrounded by a number of larger tubes, also placed in a circle. The combined area of the latter is the same as the combined area of all the small tubes, thus allowing the free and rapid return of the water to the lower drum. In order to confine the heated gases inside of the small tubes, the outside tubes are covered up to their center with special fire bricks formed in such manner as to fit around and between two consecutive tubes, and held there by metallic bands. The whole boiler, including the fire bricks, is covered with a layer of asbestos covering of sufficient thickness to prevent the radiation of heat.

It is asserted that the simplicity of construction of this boiler makes it in point of first cost lower in price than any other water-tube boiler in the market. The next advantage claimed for this boiler is that no cumbersome brick walls are required to enclose it, with their attendant ever-recurring expense for repairs. A further advantage is gained by having an internal firebox, which excludes all possibility of heat being lost by radiation, as is the case with other boilers having their fire surrounded by brick walls. Attention is also called to the free and unimpeded rapid circulation of the water in this boiler, due to the fact that the tubes are perfectly vertical and the areas of both the small inner tubes, giving the water free and unobstructed upward movement, and the large outside tubes, giving the water the best opportunity of returning to the bottom of the lower drum, are the same.

The drawings, in vertical and cross-section and of the head, explain themselves.

Stevens Institute of Technology.

The twenty-fifth anniversary of the Stevens Institute of Technology will be celebrated on the 18th and 19th of February next. The festivities will consist of a banquet at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited. On the following day the Institute will be opened for inspection, and the methods of instruction, together with the apparatus in the various laboratories, will be explained. Not the least interesting feature of the exhibition will be the collection illustrating the work of the alumni, and consisting of machinery, apparatus, drawings, etc., representing the product of their activity during the 25 years. The programme also includes a reception, tendered to the faculty, graduates and undergraduates, by Mrs. E. A. Stevens, widow of the founder of the Institute, at Castle Point, Hoboken. A promenade concert and dance in the evening will conclude the celebration.

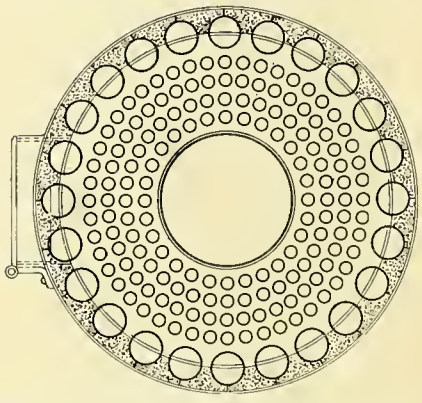
The Stevens Institute of Technology was founded by the late Edwin A. Stevens of Hoboken, N. J., and in 1870 the erection of a building was commenced by the trustees, Mrs. E. A. Stevens, S. Bayard Dod and W. W. Shippen. Dr. Henry Morton, at that time secretary of the Franklin Institute of Philadelphia, was tendered the presidency of the Institute, and gathered a faculty of eight members about him. To this number others have from time to time been added, as the work of the Institute increased, until at the present time the faculty includes 22 professors and instructors. The total number of student graduates is 675, and the number in attendance during recent years has been about 260 each year.

Senator Pettigrew of South Dakota has introduced a bill in the Senate providing that on and after July 1, 1897, no street railway company in the city of Washington shall charge to exceed three cents for a continuous trip, and shall issue 10 tickets for a price not to exceed 25 cents.

Steam-Trolley Contest in Connecticut.[1]

A most important decision in its bearings on the competitive relations of steam and electric railroads in Connecticut has just been rendered by Judge G. W. Wheeler in the Superior Court of that state. It has been appealed to the Supreme Court of the state, but the findings of the lower court are in such a form that, as regards the particular case, the decision seems fairly sure of being sustained.

Some two years ago the Central Railway & Electric

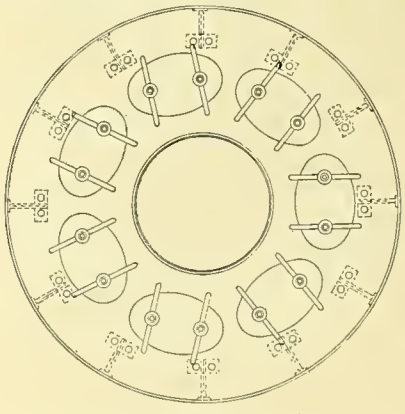


NEW VERTICAL WATER-TUBE BOILER.—CROSS-SECTION.

company of New Britain planned a trolley line for the distance of about nine miles between New Britain (population about 22,000) and Hartford, with a population of about 62,000. The new line would have paralleled both the Consolidated and New England companies' steam tracks between the two cities. The general street railroad law of the state in such cases requires a Superior Court judge to pass upon the question of public necessity and convenience, and, after a stoutly fought suit, Judge F. B. Hall, in April of 1895, ruled on that point adversely to the trolley corporation. But this was hardly more than the opening skirmish of a long legal campaign. The New Britain company joined with the Hartford Street Railway company, the most powerful trolley corporation in the state; both together took control of a third company, with a separate charter covering territory between the two cities; a fresh layout was made, with right of way largely through private land, and a new legal conflict ensued. Its manifold phases and intricacies need not be traced here, but the fact that, at the last, only with the utmost difficulty could a judge be found to try the case, indicates sufficiently its character.

The long litigation has just reached a climax, or subclimax, with the decision of Judge Wheeler, who has ordered an iron-clad injunction against the proposed trolley parallel. On its face the decision turns upon points largely technical—the defectiveness in the matter of the charters of the three trolley companies, the validity of the steam companies as parties to the suit and the partial, but legally sufficient, occupancy of a highway by the proposed parallel. But in the finding of facts accompanying the decision the judge goes much further, accepting the earlier decision of Judge Hall and the sparse population along much of the proposed parallel and consequently its essential character as a parallel between two cities and nothing else.

In more general terms the decision seems to imply



NEW VERTICAL WATER-TUBE BOILER.—PLAN OF HEAD.

strongly that the Connecticut courts will be strict constructionists of the loose trolley charters, that the public necessity and convenience of trolley roads must be invariably proved, and well proved, and that, in such proof, a well-settled region between the two points of competition is an important factor. Should the decision hold, its value to the steam railroad interests of the state is obvious, and indeed it forecasts fresh controversy of steam and the trolley in the state legislature over some of its legal consequences.

In these columns about a year ago were described some of the features of the complex contest between steam and trolley which has now been waged for several years with Connecticut as a battle-ground. During the

1. From the *Railroad Gazette*.

year there has continued with considerable legal asperity the struggle of the trolley companies to push through competing parallels, especially between cities, and the equally strenuous resistance of the steam companies, differing in legal name, but all essentially merged in the Consolidated Railroad company. The state contains 17 towns which have cities within the town limits (though in a few cases city and town are co-terminous), and 23 miles spans the longest distance between any city and the city which is proximate, the average distance being about 12 miles; yet, strange to say, at the end of a conflict of more than four years' duration, no two of these cities have been connected by new trolleys competing with a steam road and which have been constructed during that time. Indeed, it does not strain the fact to say that trolley competition of an inter-urban character does not exist in the state, so successful has the Consolidated company been in resisting the new rivalry in both the Legislature and the courts. It is true that the small cities of Ansonia and Derby have trolley connection, but the two municipalities are geographically one, as are Norwalk and South Norwalk, which are also joined by trolley lines, and, in the case of the cities of Stamford and South Norwalk, the Consolidated company owns the trolley system of the former city and has consented to connect with a Norwalk line only from motives of policy. The trolley lines connecting those two cities can not be deemed competing parallels.

The situation in Connecticut may, perhaps, be expressed more vividly by stating that from 12 out of the 18 cities of the state no competing trolley line runs to any other city, and that the 12 cities referred to include New Haven, Hartford, Bridgeport and Waterbury, the four larger municipalities of the commonwealth.

This may justly be described as a strained situation, and the strain has many places of acute tension, where something must sooner or later give way. One of those places, namely, the area of proposed parallelism between New Britain and Hartford, is referred to in Judge Wheeler's decision. A second is between New London and Norwich, inclusive, where a flaw in the organization of one of the associated trolley companies has blocked a trolley parallel, and the appeal from the lower court to the Supreme Court of the state was argued at Norwich a few weeks ago. There is also a danger signal for the Consolidated company in a suit brought before the Superior Court of New-Haven county to determine the public necessity and convenience of a projected trolley to connect New Haven with Derby and Ansonia and parallel the old New Haven and Derby steam road, now a part of the Consolidated company's Berkshire division and a very large local passenger carrier. In some other directions new trolley parallels are nearly or quite accomplished facts. One is just about to be opened in the town of Enfield to Longmeadow and soon to reach Springfield, Mass. Another has pushed through to Talcottville, on the New England road, presumptively very soon to connect the city of Rockville with Hartford; yet another has just joined the city of Middletown with its neighbor, Portland, across the Connecticut River, and is stretching northward toward Hartford. Altogether there was a year ago in the state 103 miles of trolley roads paralleling steam lines. There is now about 128 miles, showing that while the Consolidated company has, on the whole, been singularly successful in the long campaign, its "trocha" has, in places, been broken, and the warfare is certainly far from ended. In the coming Legislature that warfare seems likely to be continued with the utmost vigor.

The financial and other questions of serious moment forced on the Consolidated company by its vast scheme of improvements, including the costly four-tracking, the Boston terminal scheme and the recasting of the New England management, have, for the time, somewhat diverted its management from electric schemes of its own. It has acquired recently no additional trolley roads and, beyond developing plans on the Nantasket branch and its Stamford plant, and in the suburbs of Boston, its policy has been defensive rather than aggressive. Perhaps this has been due to the fact that not only has its largely increased freight traffic more than made good losses from trolley competition, but those losses themselves have been somewhat less than were feared. The road carried in the fiscal year ended June 30, 1894, a total of 44,448,324 passengers. The number was reduced, presumptively by trolley competition, to 43,838,676 passengers for the year succeeding, but the figures rose slightly last year to 43,970,932, a number, however, considerably below the figures for 1894. On the whole, therefore, the competing trolleys seem now to be cutting off what would probably have been gains in local passenger traffic rather than making very positive inroads on traffic of the kind already existing. But the time is hardly remote when the great corporation must turn sharper attention to the electric competitions, present and prospective, and events in the Connecticut Legislature soon to meet may force its hand. If not, then the hottest struggle will come when inter-urban competition develops in the state. It is a thing that must apparently be faced sooner or later and, when it comes, if the Consolidated company carries out its suggestion of electrical equipment of one of its multiple tracks, the new rivalry with "express service" as an element will supply some instructive results. That, indeed, was the method by which the Consolidated company has proposed to meet the threatened rivalry between New Britain and Hartford, now postponed by Judge Wheeler's decision, but hardly thwarted. The situation in Connecticut is only a more highly developed and organized form of what is found to-day in half a dozen other regions; and it sums up in a compact way one of the most formidable set of questions now before the railroads.

An Electro-mechanical Monkey.

The illustrations herewith presented show an original and ingenious advertising device for a show window attraction, invented and manufactured by R. H. Little of 2125 Indiana avenue, Chicago.

Fig. 1 gives the general appearance of the automaton

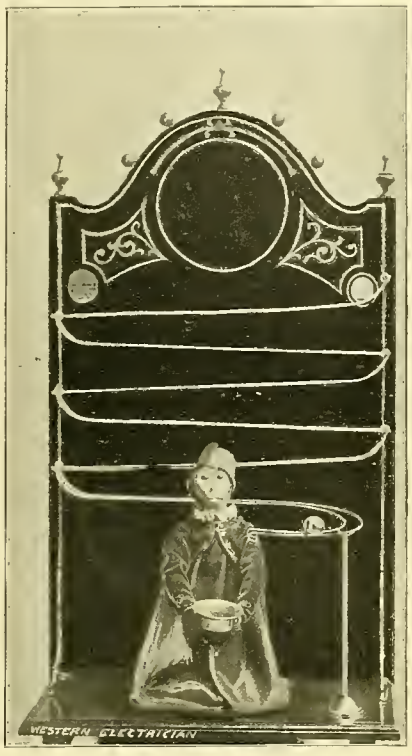


FIG. 1. AN ELECTRO-MECHANICAL MONKEY.

and its appurtenances. The figure is sitting in a crouching position on a platform 12 by 24 inches, behind and attached to which is a board 40 inches high, on which to display advertising matter. A hollow brass ball, when dropped into the cup which the monkey holds in its paws, causes the figure to rise suddenly and fling its arms up, throwing the ball against a curtain hung behind an eight inch circular opening near the top of the board. This curtain serves to break the force of the ball and swings back, allowing the ball to be caught in a pocket behind, from which it rolls through the small hole to the right

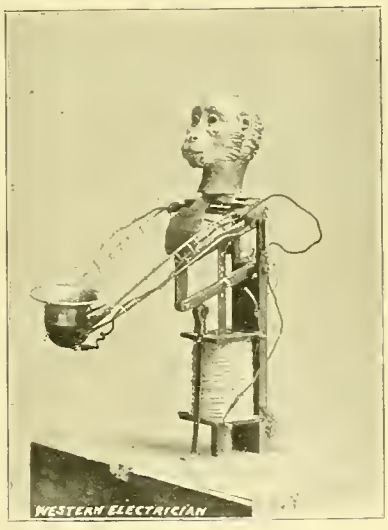


FIG. 2. AN ELECTRO-MECHANICAL MONKEY.

onto a wire track and thence down into the cup, ready for a repetition of the operation, which occurs about every 15 seconds.

In Fig. 2 the interior mechanism is shown. Electrical connection is made with a 110 volt circuit by a plug and socket behind the upright board, and from which wires run to contact brushes in the cup. When the ball drops into the cup the circuit is completed, and a solenoid, acting on levers, raises the body of the figure five inches, and at the same time a short lever attached to the arm movement at the shoulders is held back, causing the arms to rise and throw the ball, thus opening the circuit and allowing the parts to drop back to place again. A parallel rod connects the shoulder and cup, to admit of the cup being adjusted to aim the ball properly. All movements are counterbalanced by adjustable springs to relieve the solenoid, which is four inches high with an iron core one inch in diameter. A small graphite rheostat is used to protect the coil, which is wound with No. 20 wire, from undue heating, and as the current is on only about one second in every 15 the apparatus seems to be capable of operation for an indefinite time. The idea is to have the principal feature of the advertisement on the circular curtain, to which attention is especially directed by the movement of the ball.

Sensation of a 2,500 Volt Shock.

[From the *Lancet*.]

The following details of a recent electric accident are interesting and may be useful. On November 20th an electrical engineer was standing on a chair ready to move a reversing switch on the arc lamp side of a rectifier for lighting a series of 60 lamps (3,000 volts). He casually placed his hand on the metal cover of an ammeter (which was in series with another 60-lamp circuit) and, turning to the left and leaning back to make an observation (still standing on the chair), he placed his left hand on an iron pillar. Now, the ammeter case proved to be in metallic contact (accidental) with the light leads, and as the return wire was "earthed" there played through the body from hand to hand a current under a pressure of (nominally) 3,000 volts. As a matter of fact the electromotive force tested between the points of contact by a Kelvin electrostatic voltmeter proved to be 2,500 volts.

He says that the first thing he realized was that he found himself standing on the floor, but has no clear idea as to whether he jumped off or was "knocked off." The forearm was "drawn up close to the chest" and the hands clenched. From a little above the elbow downward he described a "feeling of pulsation" and a violent beating in exact step with the alternators (running 83 periods per second). All power of movement below the elbow was absolutely lost, but the arm at the shoulder could be moved from the side. The pulsations, although still retaining their periodicity, soon became less violent, and motor power returned successively in the muscles that move the elbow, wrist and fingers. In three minutes he felt "none the worse." There was no sensation of burning at the moment, but 10 minutes afterward the hands became painful, and examination showed a burn on the tip of the left middle and ring fingers and on the back of the right little and ring fingers, with a seared line across the lower portion of the palm. There has been no other effect excepting that he expresses himself as feeling "decidedly better in general health."

What current did the body receive? With the contacts named I estimate that the resistance of the body might be 10,000 ohms.

Anti-Bell Victory in Marquette.

According to a correspondent of the *Chicago Record*, a competing telephone company has scored a decisive victory in Marquette county, Michigan. The story is told as follows:

The Bell telephone monopoly still flourishes in many parts of Michigan, but in Marquette county it is dead. Eighteen months ago the Marquette County Telephone company was organized exclusively by local capital. None of the men putting money into the business knew anything about telephones, but they were wise and hired expert managers. Careful tests were made of the various forms of instruments offered and the line was built of the most expensive material and in the most durable manner. The stockholders did not grow scared because it required more money than at first figured on to complete the system and they cheerfully furnished money whenever it was needed. The rates were put down to bottom figures, a yearly rental of $30 being fixed for business houses, in place of the Bell rental of $60, while for dwellings a rate of $15 was made in place of $40 charged by the other company.

These prices were met by the Bell people, but without avail. In a few months the local company had three times the subscribers that were on the list of the old concern and at present the ratio is about 10 to one, and steadily growing in favor of the Marquette county institution. The local concern, despite the great depression in business, has secured 260 subscribers in this place, nearly as many in Marquette and more than 100 in Negaunee. The Bell company never had as many 'phones in use in the entire county as the new company now draws rental from in Ishpeming alone.

There is no longer a question that the Bell company is thoroughly whipped and that it must sooner or later withdraw from the field in which it is now steadily losing money. Had the Bell people made concessions to their patrons here before the organization of the new company, they might have been able to hold a share of the business, if not, indeed, retain sole possession of the field.

The Lehigh Light & Coal company, near Dickinson N. D., has put in an electric plant and mines coal by electric power. In the spring the company will extend wires to Dickinson and furnish electric lights for the city.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

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TELEPHONE, MAIN 1746.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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EXCEPTIONAL interest for us, and, we trust, for our readers, attaches to this, the twentieth volume, on which the WESTERN ELECTRICIAN has now entered. The completion of this volume will mark the first decade of the journal's existence. The period has been one of extraordinary change and activity in electrical applications. The record has been kept in these columns, and it will be enough at this time to point out the anniversary.

Despite the fact that the year 1896 has been one of business depression, the electrical industry has steadily advanced, particularly in the railway field. The triumph of electric traction may now be said to be complete. Notwithstanding the opposition of the great daily papers, which seem to have been banded together for the purpose, the overhead trolley is now omnipresent in every large American city, with the single exception of New York, and even there the trolley conduit system gives promise of practical electric railway operation. This is a striking victory, and it is due in no small degree to the faithful service of the electrical press, in which the WESTERN ELECTRICIAN took its fair share throughout the country generally, and in the West, of course, a predominent share.

The telephone field has broadened and may soon become entirely open. The WESTERN ELECTRICIAN, almost alone among the electrical papers, has labored faithfully to this end, believing that the owners of the basic telephone patents have already enjoyed the full benefit intended by our patent laws, and should now be satisfied to see the operating companies and the people generally come into the use of the telephone under more liberal conditions.

In doing its best to serve the electrical interests of the country, and particularly of the West, the WESTERN ELECTRICIAN is happy to report continued growth in the face of dull times. The average issues of 1896 were larger than in any previous year, and for 1897 a still further gain can be confidently predicted.

Facing the improved prospects of the year before us, the WESTERN ELECTRICIAN renews, for 1897, its pledge to give its best efforts to the industry which it has always sought, and still seeks, to advance.

DO NOT forget the forthcoming convention of the Northwestern Electrical association at Milwaukee, beginning on January 20th. The programme of papers to be read, already published in the WESTERN ELECTRICIAN, shows that some topics unusual to the formal sessions of electrical conventions are to be discussed. The meeting promises to be of much interest. Especial railroad arrangements have been made, and there should be a large party from Chicago.

WHAT has become of the credit association that was to be formed of the electrical supply dealers and manufacturers' agents in Chicago? Several months ago the project to form an organization of this character, to afford mutual protection in extending credit, bade fair to crystallize into one of the institutions of electrical trade in Chicago. The idea is a good one; it should be welcomed by all honest debtors and can easily be carried out by the creditors without interfering with fair competition. Associations of this character have been notably successful in New York and other eastern cities—why not in Chicago? We are noted for our civic pride, but in this instance there has been a conspicuous lack of it. What is the matter?

A FEW years ago a Missouri court was called upon to consider a case of theft of electric current, and there was much discussion whether, in a legal sense, such an imponderable thing as electricity could be stolen. If memory serves, the court, in that case, took the common-sense view, and decided that there was a legal remedy for the deed of which complaint had been made. It seems, however, that in Germany the opposite opinion prevails, and a man who was accused of stealing several thousand amperes of current from an electric light company's wires, using it to run a motor, was acquitted on the ground that only a material object could be stolen. This seems a very short-sighted—not to say fatuous—view of the matter, and one which, it is to be hoped, will never prevail in the United States.

A DESERVED rebuke is that administered to the meddling *Daily Telegraph* of London by our English contemporary, the *Electrical Engineer*. "The *Daily Telegraph* having failed in an attempt to present a testimonial to the United States ambassador—which, if one could conceive him accepting it, would have driven some Americans frantic—has taken up the 'beauties of Niagara' agitation," it says. "A 'special correspondent' in New York has discovered that 'a scheme is at work to spoil Niagara. Only a few days ago the American journals were rejoicing that at last the mighty giant was harnessed. Two or three years back a concern, calling itself the Niagara Falls Power company, sought the right to intercept the current above the rapids, and by turning its energy into electricity, make dollars for themselves.' Moreover, Chicago now sends her sewage (ultimately) into the Mississippi instead of into the lake. There are two columns of this sort of thing, but as our contemporary is rather behind the times in this special matter for an up-to-date daily, one need not reproduce it. The right has been obtained, the work has been done, and the landscape and general amenities of the falls are none the worse for it. Moreover, all the world, except the *Daily Telegraph*, knows it. The Americans are quite capable of taking care of themselves, their country, their interests, and their ambassadors without our British assistance—and they very much prefer to do so. Why cannot our contemporary let them alone,'? These are very sensible words, although whatever the *Daily Telegraph* chooses to do is of indifferent concern, of course, to Americans. Still, such "enterprise" as our contemporary mentions is obviously futile and silly.

EVERY new development in electric railway practice and every extension of the system seem to create a demand for apparatus to lend additional safety under the new conditions created by the increase in the rate of speed adopted. On the surface roads in large cities it has become the rule to operate trains of two or more cars, and this has directed attention to the inefficient methods employed upon most of the trolley lines for controlling and stopping the cars quickly where trailers are employed. In cities where each car is equipped with motors the necessity of improved braking apparatus is not felt, but on many lines in Chicago and other large cities two and sometimes three cars are attached to a motor car, and the old brakes are relied upon. There have been several accidents which might have been averted had the operating companies taken the trouble to equip their cars properly, but this feature seems to have been neglected by the management and entirely overlooked by the public. The question of expense probably deters the management from taking the necessary steps, but public safety and the good name of the trolley system should make city officials and manufacturing companies combine to secure the introduction of an efficient system of braking. Wherever high speed and trains of two or more cars are adopted this matter should be carefully considered.

DISTANCE lends enchantment to the view of horseless carriages as of everything else. Not that the new vehicles are not equally satisfactory on closer inspection, but rather that the exploits of foreign equipments of this character seem to have a far greater charm to the average daily newspaper than the equally meritorious accomplishments of similar cabs, carriages, wagons or what not right at home. Thus, in a recent issue of the *New York Herald* several inches of presumably valuable space was devoted (not without due and careful credit to the "European edition of the *Herald*") to a description of a new outfit in Paris—le coupé-huit-ressorts-automobile-electrique Darracq, to be exact—in which the *Herald* reporter was "motored" about in the Rue Duret for a few minutes very comfortably. The description of the coupe shows that it is an almost exact counterpart, so far as mechanical equipment is concerned, of an electric carriage seen frequently on Chicago streets. The driver's seat is in the rear, instead of in front, but the motor, storage battery, steering gear, brake, pneumatic tires, are all the same, only that the American firm seems to have made a lighter and therefore better carriage. Why, then, so much clack over M. Darracq's vehicle? There appears to be no reason except the glamor of the foreign haze which so many of our New York friends experience when looking seaward.

IT is significant that after carefully examining all the systems of street railway transportation in operation, actually or experimentally, in this country, the committee of the Glasgow corporation has gone home and reported in favor of the overhead trolley for the Scottish metropolis. The investigators composing the committee are very cautious and sure-footed about it all, but when all is said, as will be seen by the abstract of their report on another page, they recommend that an electric line, to be supplied from overhead construction, be built in one of the principal streets of their city. Their handling of the old esthetic objection to the presence of the poles and wires in city streets is broad and reasonable. They take the ground that the main thing in an industrial city is the securing of the greatest good to the greatest number. Nothing conduces more to this end than means enabling the working classes to provide decent and comfortable homes for themselves. Such dwelling-places are a necessity to "make it possible for the individual members of an industrial community to live beautiful lives and build up beautiful characters." Thus, arguing that the beautiful characters of its citizens make a city beautiful in the highest sense, and showing how electric traction furnishes to the poor the possibility of attractive homes in the suburbs, by furnishing cheap and rapid transportation, the committee concludes that, in the last analysis and in the best conception of pulchritude, beauty itself demands the electric railway—poles, wires and all.

There is much in this interesting report that can be read with profit by the corporate officers of American cities.

American Street Railways Seen Through British Eyes.

Judged by American standards, Glasgow is the most enterprising and progressive city in Great Britain, although the improvements have been carried out in a spirit of municipal paternalism which would hardly be allowed in this country, in the present state of public opinion. The transportation problem has been for some time engaging the attention of the city authorities, and the various methods of street railway traction have been carefully considered. The United States was considered to offer a fruitful field for investigation, and a committee was sent here. The report of this commission of inquiry has just been made. It is candid and interesting. The following abstract is taken from the *Electrical Engineer* of London:

In accordance with instructions, we have visited America and investigated the various forms of tramway traction. We sailed from Liverpool on September 19th, and after seven weeks' absence arrived home on November 7th. The places we visited in pursuance of our investigation embraced the following: New York, Brooklyn, Jersey City, Staten Island, Philadelphia, Baltimore, Washington, Pittsburg, Cincinnati, Chicago, Detroit, Cleveland, Buffalo, Niagara, Toronto, Montreal and Boston. In all these places we had the pleasure of meeting the leading street railway men. We also saw the mayors of some of the most important cities, and visited the works of the principal manufacturers of street railway equipments. We desire to place on record our high appreciation of, and hearty thanks for, the courtesy and kindness shown to us by one and all of the many gentlemen in all these connections whom we had the pleasure of meeting in America. They all did their best to make our visit pleasant as well as instructive and useful. We took it as a compliment, not so much to ourselves as to the old country, and specially to the city of Glasgow, on whose behalf we were collecting information. We shall not be redeeming our promises if we do not heartily embrace every opportunity which presents itself of returning the compliment.

In America tramways are universally styled street railways, and the overhead electric system is usually spoken of as the trolley system. It will also be understood in this report that miles of track means single track where double track is not specially mentioned. Operating expenses per car mile, are, as a rule, given exclusive of interest and municipal taxes, which usually include all payments in connection with the franchise or the right to construct and operate.

The authors proceed to give details of the equipment in the various towns mentioned above, and then proceed to draw conclusions as follows:

It is about the lifetime of one generation since tramways or street railways became recognized as a necessity of city life. Ten years ago, with the exception of a few cables in San Francisco and Chicago, horse traction was universal. Wonderful changes have taken place since then. Many forms of traction have taken the field, and there has been a fierce and continuous struggle for the supremacy. One outcome of all this has been enormous development. In 1890 (not to go further back) there were 9,037 miles of street railways in the United States; 5,400 miles were operated by horses, 510 miles by cable, 604 miles by steam, and 2,523 miles by electricity. The return for 1896 shows that they have increased to 15,956 miles; of which 1,351 miles were operated by horses, 612 miles by cable, 384 miles by steam, and 13,609 miles by electricity. Within the last five years the number of horses used in operating tramways in America has declined by no less than 80 per cent. Without waiting to trace the history of the traction struggle we shall endeavor to refer to and discuss the different forms of traction brought under our notice on this visit. They have practically all been discussed in former reports already in your hands, but we shall speak of them as seen and judged of in America.

Storage Batteries.—This system was tried some years ago in Washington, among other places. After a large amount of money had been expended on experiments the system was given up as a failure.

Oil and Gas Motors.—Mr. Yerkes of Chicago was at great trouble and expense testing the Connelly motors, but they proved unsuccessful, as well as unpopular, and he threw them aside. This is the system which your sub-committee inspected at Croydon. So far as we could learn, there are no other oil or gas motors in America.

Compressed Air.—Mr. Hardie has been working on compressed air motors for some years, and has three of his cars now running in New York. They cannot be said, however, to be either sufficiently successful or popular to be seriously considered for adoption at present.

The latest compressed-air motor which has been brought out—and it has been done with a considerable show of influence—is one patented by Mr. Knight and Mr. Whitney. The former was one of the patentees of the Bentley-Knight conduit system, and the latter is largely interested in street railways. The first of the Knight-Whitney cars was placed on the Lenox avenue route during our visit, and we had the pleasure of riding on it with Mr. Knight. All we can say is that the car seemed to run all right throughout the double journey (fully five miles) with one charge. But it would be rash to express an opinion regarding the future of anything of this kind in its first experimental stage, although it seemed to us the best compressed-air system yet produced.

Electro-magnetic Systems.—Closed-conduit or magnetic systems have as yet made no headway in America, nor, as far as we could learn, are they looked upon with much favor or hope of practical success. In point of fact, so far as we are aware, no street railway company is at present even experimenting with them.

Electric Open-conduit or Underground Systems.—Electric open-conduit installations—modification of Siemens & Halske's Budapest system—have recently been put down, and are being experimented with in Washington and New York. In both cities the overhead system is forbidden. The two experiments are closely allied, and differ only in details. The slot, instead of being in the side rail as in Budapest, is in a third rail in the center of the track, similar to the ordinary slot for the cable gripper. In Lenox avenue, New York, the conductors in the conduit are of channel iron for one portion, and 1¼ inch steam tubes for another, while in Washington it is T-iron. The cost of construction is spoken of in America as practically prohibitory, and the special work at junctions and crossings is very expensive, one junction in New York having cost £15,000. In Washington the capital outlay for track and equipment is given at about £20,000 per mile of single line, and in New York the track alone is said to have cost that amount; and, of course, the horse track and the asset it represents are wiped out. Last winter there was little frost or snow, so that these underground experiments have not been tested through a severe winter. Both in Washington and New York the cars have been stopped for a short time during heavy rains, but while we saw them in dry weather they were running very well and seemed nicer to ride in than cable cars, and were evidently more popular. One drawback specially spoken of in connection with the operating of the underground system is the great difficulty of locating the defect when anything is wrong. And, of course, apart from snowstorms, there is the difficulty in wet weather of efficient insulation through damp and slush. We observed the electric lighting of the cars working on this system was not quite satisfactory. The lights were dim at times, and went out altogether at the junctions. The streets and climate of Washington are, no doubt, specially favorable for an underground system. Dry weather prevails; the streets are wide, well formed and clean; and on the underground routes there is practically no vehicular traffic heavier than buggies and bicycles. Lenox avenue, New York, is also specially adapted for the system—long, straight lines, and a clean, wide street, with only light traffic. The company who own this line and have been experimenting with the underground electric system are the same who have now begun to experiment with the latest compressed-air motor. Evidently they are not so satisfied with the results of the underground experiments as to justify them in proceeding further in that direction at present. They consider the cost of construction prohibitive, and have recently cancelled contracts made in connection with proposed extensions of the electric underground system, just as they had done previously with contracts for cable extension. A short length of the "Love" electric conduit system is still operating in Washington, but a similar experiment has been abandoned in Chicago. As mentioned in our notes under the heading of "Washington," the chief difference between the "Love" and the other underground electric systems is that it has a rolling contact, whereas the others have a sliding contact. Were money no object, and financial results not to be reckoned, an underground electric system can, in a dry climate, be operated where there is sufficient depth (over two feet) to construct a conduit. But it seems very doubtful indeed if, for a city and suburban system, even where that depth can be got, it could be made a commercial success, and all the more so in a damp climate like ours. It is well known that the Central railway construction has made it impracticable to have this system in Argyle street. On the merits and demerits of the open conduit we have learned nothing which casts the slightest doubt on the thorough soundness of Mr. Arnot's views as expressed in your sub-committee's Continental report. And in any case, with our present knowledge, we could not see our way to recommend the spending of money in entirely throwing away the present tramways and the assets represented by them; and constructing an underground system, which is of necessity so expensive to construct, does not admit of general application to all lines of the system, and is only in the experimental stage, both commercially and from the operating point of view, more especially if there is a proved system which is satisfactory and admits of utilizing the present roadbed and is cheaper in every way. We feel bound always to bear in mind that the Glasgow corporation tramways have no rating powers to fall back upon.

Cable System.—The cable system in the earlier days promised to be largely employed in street railways. However, one cannot pass with open eyes and ears through the cities of America without being thoroughly satisfied that it has been superseded. The American street railway men, one and all, speak of it as a "back number." The practical proof of this is that many miles of cable lines have been thrown out in such cities as Philadelphia, Baltimore, Pittsburg, St. Louis, and even in San Francisco, the home of the cable system. We ourselves saw miles of cable conduits being taken up, and the tracks being reconstructed in every case for the electric overhead system. We also saw a few first-rate cable lines in the United States which are not likely to be disturbed in the meantime. The most notable of these are the trunk lines in New York, Chicago and Washington. The New York authorities meantime forbid the overhead trolley system, and cables have, at an enormous cost, been put down in some of the busiest thoroughfares, including Broadway, which has the very busiest street railway in existence. They are all working satisfactorily and successfully, but the management make no secret of their preference for the overhead electric system—if they could get it. In like manner, cable lines are running very successfully in Chicago, in such busy thoroughfares as State street and Wabash avenue—ideal cable routes—as also in the main arteries of a few other cities. In all such cases, however, the cables occupy the trunk lines—corresponding to our Argyle and Renfield streets—and no fair comparison can be made of the operating of such routes and the outside routes which feed them. On the average routes the cable system is more expensive than the overhead electric, and is considered rigid and cumbrous by comparison. There is no probability of the cable system being extended in any of the cities. On the contrary, there is a probability that when the construction or equipment requires renewal this system will give place to the more flexible and popular trolley.

Electric Overhead or Trolley System.—This is now undoubtedly the standard system of tramway traction in America. This is borne out by our notes in the various cities visited, and even more strongly by the actual facts. The invention of a patentee may, on its first appearance, be more or less successfully launched according to the backing it receives from the interest or influence of men of means and position. But no such influence can permanently affect the survival of the fittest. We cannot and need not say anything about the future. But up to the present time there is no difficulty whatever in making-up one's mind as to the best surviving and fittest form of street railway traction in America. Street railway managers and engineers have only one answer to the question, From your experience, and taking both efficiency and economy into account, what is the best form of tramway traction for Glasgow to adopt instead of horses? With unanimous voice they answer: the trolley. Each of the patentees and owners of other systems only claims that his system is the best where the trolley is prohibited. And at home we have heard the admission made that the reason why they don't want us to begin with a section of the overhead system is because they are convinced that if we began with it we would have nothing else.

Electricity has undoubtedly played the leading part in developing street railways in America. The trolley system was only introduced some eight or nine years ago, and since then the mileage of the American street railways has been practically doubled, and at the present time no less than 85 per cent. of the total mileage is operated by the trolley, and the percentage is daily increasing. The system had undoubtedly a crude beginning. In a new country all railroads or street railways must of necessity be constructed in the readiest and cheapest way possible. When the district traversed comes to be more settled and populous there is, of course, so much more money and traffic as to admit of a more permanent construction. Horse tramways were, as a rule, in America first laid down in very temporary fashion. Light rails were simply laid on cross-ties or sleepers, to which they were spiked, and the ground leveled up or roughly paved, as the case might be. These rails carried the small horse cars in a way, but were totally insufficient to carry the heavier electrical cars at the higher rate of speed. When, therefore, electrical cars were introduced, the whole track had to be thrown out and laid with much heavier rails on a much stronger foundation. In early examples of the electric system the appearance of the overhead construction does not seem to have entered into the minds or calculations of the constructors. This is not to be wondered at. Their chief aim was rapid transit and development. And they were accustomed to seeing the obtrusive wooden telegraph poles on the sides of their streets carrying the telegraph wires, and, later, similar poles carrying the telephone wires in rapidly increasing numbers. The side poles necessary to carry the cross-wires for the trolley were insignificant and beautiful by comparison, and so they stuck them up as fast as they could. The people got rapid transit and were delighted. Meantime, in some of the leading cities the appearance of the crude telegraph and telephone poles, and the innumerable wires they now carry, roused the municipal authorities. This was especially the case in New York city—the same city which had sanctioned elevated railways over their streets, which for ugliness have no rival. Whatever they may think of their elevated railroads, they were undoubtedly right in abolishing the huge wooden telegraph and telephone poles, which even yet disfigure most American cities. In many cases state or municipal ordinances have been passed requiring that in five years all telephone wires within certain areas shall be placed in ducts underground. Thus the objectionable poles have disappeared in New York, and are disappearing also in Washington, Boston, Chicago, etc. And no doubt all the chief cities will see it to be their credit to remove these eyesores. New York has evidently gone off to the other extreme, and will allow no overhead wires whatever. Washington has taken the same position, although the capital has still a good many of the old telegraph poles in her principal avenues. Chicago for a time declined to sanction the trolley system down-town, but on the pressure of her own ratepayers the municipality is relenting, and very soon, according to Mayor Swift, the up-town trolleys will run right into the center of the city. The commissioners of the District of Columbia have also forbidden the introduction of the trolley system into Washington. We need scarcely refer to Washington in this connection, however, as it is a place by itself, and has little or nothing in common with a busy commercial city. With these exceptions every city in America has got, and is well served by, the trolley system, and in no case has the overhead system, when once introduced, ever been abandoned.

After seeing the best overhead construction for the electric overhead system, and considering its vast importance as a means of rapid transit of passengers on

city and suburban streets and roads, we are perfectly reconciled to it, and feel that it only wants to be seen in use to be appreciated. Boston seems second to no city in her wish to regard her amenity, and Boston has the trolley everywhere. Mayor Quincy gave us freely his views on the overhead system from his point of view as representing the citizens, and they are in favor of the trolley, which during the last few years has done so much to develop the city. The city of Philadelphia ranks high among American cities. Mayor Warwick, of that city, was quite as frank and strong in his testimony in favor of the trolley, so general and popular in his city. It of course goes without saying that if a system as good and as cheap can be had without any overhead construction we should prefer it. But there is none such known at present. And we feel sure that if the citizens saw this system of rapid transit in operation on the Springburn route—comfortable cars, propelled, illuminated and heated by the same power—they would not for a moment object to the appearance of neat poles to carry the wires, especially if the old lamp-posts were done away with, and the trolley poles made use of for electrically lighting the streets. We believe the citizens would soon conclude that it was beautiful as a whole.

Glasgow, as the commercial metropolis of Scotland, must continue to be a city of enterprise and industry. As such let us make it as artistic as we can. Is not the most beautiful ideal of an industrial city, however, one in which all classes of citizens have decent houses to live in as well as plenty of work by which they can earn sufficient money to meet their reasonable wants? These are the necessaries which make it possible for the individual members of an industrial community to live beautiful lives and build up beautiful characters. They must therefore occupy a foremost place in the city which is to be beautiful in the highest sense. Civilization demands that the æsthetic give place in many instances to the useful. We never were prouder of Glasgow than when we heard of the high place assigned to her as a municipality by the Americans. But we have not served 20 years in the health department, and been acquainted with "life in one room," without knowing Glasgow's blemishes—and they are common to all our older cities. One great city improvement scheme has been carried out in our city, and another is now being favorably considered. In Glasgow as it was five years ago there was a population of 565,714 on an area of 6,111 acres, giving 92 persons to the acre, or 58,800 to the square mile. In the present Greater Glasgow, apart from the adjoining but still separate burghs, we have a population of 705,000 on an area of 12,311 acres, giving 57 persons to the acre, or 36,480 to the square mile. When the four separate burghs now served by our tramway system are included we have a population of 841,000 persons on an area of 14,661 acres, which also gives 57 to the acre, or 36,480 to the square mile. No American city, with the exception of New York, is half so densely populated. No one wishes our citizens to continue so closely packed together as they now are. How are they to be spread out? In our humble opinion, and judging from what we have been privileged to see in America, the most powerful instrument which lies to the hand of the municipality for effecting this purpose is the best and cheapest possible tramway service radiating from the center of the city outwards in every direction.

Such a system must be safe, rapid as far as consistent with safety, elastic as to speed, clean, comfortable and attractive, flexible enough to apply to all routes and contingencies of street traffic, and, of course, as cheap as possible; and it would be all the better if each route had its suburban attractions in the shape of a park for music, and the usual facilities for amusement and recreation generally. As surely as you give cheap and rapid transit, which will enable all sorts and conditions of people living at a distance to travel comfortably to and from their work in the city, so surely will houses to accommodate them be built on cheaper ground—meaning cheaper rent—and with healthier surroundings. From all we have seen, we are of opinion that the overhead electric system of tramway traction reasonably fulfills these conditions. Its safety depends upon reasonable care and judgment as to speed and general working. There is practically no danger from the overhead wires, provided ordinary care is exercised in maintaining them properly. No man, so far as we could learn, has been killed by the current from the trolley wires. We have seen dozens of men who have had 500 to 600 volts without injury—in fact, almost every switchboard man has had it, some over and over again. They don't take it because they like it, but they have had it all the same. The president of the West End company of Boston told us that they had comparatively more accidents with the horse cars than with the electric cars. If this can be said of the system in Boston, there is no reason why it should not apply to Glasgow, for Boston has the overhead system throughout, and down-town the traffic is much more congested than in any part of Glasgow. The mayor of Chicago expressed his opinion that the lieges in his city suffered more from bicycles than electric cars. Then the question of electrolysis is one which may freely be dismissed. We were well assured that by working to the Board of Trade regulations there can be no trouble in this connection. Under the rough-and-ready way in which in the early days the trolley system was installed, it is no wonder that electrolysis resulted. The returns were very imperfect. Where the return is sufficient electrolysis is unknown. Where there have been indications of electrolytic action on gas or water pipes, engineers have had no difficulty in arresting it.

With regard to speed, the electric cars are under perfect control, and can run at any speed. There is no reason why on the average 50 per cent should not be added to our time-table speed for horse traction.

The electric system is eminently flexible. The cars can be backed when necessary (which is not the case with the cable system), and they can easily be turned on to any route. And it is a system which admits of an easy extension of routes in longer or shorter stages as circumstances require. That an electrically propelled car can be made clean, comfortable and attractive by good seating, good lighting and heating if necessary, is beyond a doubt, and these are very strong points in favor of electric traction. We believe that the poles, if of neat design and judiciously used for street lighting, can be erected so as not to offend the eye. Where the buildings are continuous, the overhead construction is least noticed. If the cross-wires were fixed to the buildings, as in Hamburg, no poles would be necessary at such places, but it might look as well to have side poles throughout. That electric traction is cheap has also been clearly established, and all the more so when all that it fulfills is taken into account. So great and so general have been the changes in operating companies through amalgamation and consolidation, that it is now almost impossible in very many cases to get from books or accounts exact figures bearing on the cost of operating by horses prior to the substitution of electric traction.

It may be remarked here that these changes have led in very many cases to over-capitalization, chiefly through watering of stock. In a published table we have seen that in the case of one large company it takes no less than 58 per cent. of the total earnings to pay interest on capital liabilities. The published returns dealing with 15,425 miles of American street railways show that, over all, the capital stock and funded debt amount to £18,293 per mile of single track. In New York state the average is nearly double, being £36,560 per mile of single track. This may explain the reason why a large proportion of the street railway companies in America are not paying dividends. There is no doubt, however, that the companies who have conducted their business throughout on sound financial lines have, as a rule, very good properties at the present time. Although there was difficulty in getting comparative costs of operating in as many instances as we should have liked, we have given some good and reliable comparisons under the headings of the various cities. In addition to these, a deal of information regarding costs was given to us on the understanding that it was not for publication. These we have taken with the other to arrive at an average. Taking them on the average, the percentage of operating expenses to receipts with overhead electric traction in America is at least 15 per cent. less than with horse traction. The operating expenses per car per mile are, on the average, 2d. less than with horses. There are further financial gains to be taken into account. On the average, as compared with horse traction, the speed of the cars in America is accelerated by over 50 per cent., and the additional traffic developed by the substitution of electric traction has not been less on the average than 25 per cent.

It is true that the development which has taken place in Glasgow since July 1, 1894, may have made it impossible to realize such favorable results here, but we are confident that the results will be all in the same direction, even although the cost of conversion doubled our capital, as in Boston. No doubt it will be borne in mind that an object lesson of 2½ miles cannot be expected to produce as good results as the operation on a large scale of an entire system. It should also noted in this connection that Glasgow is much better served by city and suburban railways than are the American cities. The fare which is universal in America is five cents (2½d.) for any distance the car travels, and most companies also give free transfers to other routes in certain directions. A few companies sell discount tickets slightly reducing the five cent fare. The Americans are quite astonished at our one-cent fare, and also that their minimum is practically our maximum. There are no cars—cable, electric or horse—in America with top seats like ours, the obvious reasons being the extremes of the climate. Seats on the roof of the car would be too hot in summer and too cold in winter. In most cases close cars are used in winter and open cars in summer. The adoption of the trolley does not interfere with the use of the top seats.

In the matter of organization and management generally we did not consider America in advance of the old country. The cars in America do not carry half as many passengers per car mile as ours do in Glasgow. With regard to the permanent way, there are certainly some points in their track construction which we have very carefully noted, and particularly the rail welding, but, on the whole, there is scarcely a track up to the present time in America equal to what we have recently been putting down in Glasgow, and in very many cases electric cars are running in America on tracks very much inferior to the Glasgow horse tracks. American managers and engineers, while they smile at our still continuing to operate with horses, at the same time congratulate us on our having been able to wait. The pioneers of the electric overhead system have come through a trying and expensive experience. The first motors, generators and equipments were crude, and had soon to be thrown aside in favor of newer designs. These also in their turn became obsolete. Even up till within the last two years great improvements were made, but now it is generally believed that engines and generators, motors and line equipments have all been by experience so much improved that now they are practically standardized, and they can undoubtedly be bought at very much less money that at any former time.

The adoption of large units from 1,000 horse power to 2,000 horse power has very considerably cheapened the cost of production and maintenance in the power station. Electric motors are not only immensely improved, but they now cost only about one-fourth of the price charged in the early days of electric traction, and all the latest electrical equipments are much reduced in price. The result of improved motors and equipments is that the cost of maintenance has been reduced from three cents per car mile to one cent. One of the greatest improvements has been in the controller. The series-parallel controller is now almost universally used in America. It not only enables the driver or motorman to regulate the speed to a nicety, but it is also fitted with a reversing arrangement by which he can not only back the car, but can also cause the motors to act as an emergency brake should occasion arise. By its use there is also a great saving in current as compared with the rheostat formerly used.

Under these circumstances we feel that nothing has hitherto been lost by delay. We also believe that the time has now come when it is perfectly safe to make a move on a small scale, and are satisfied that the opportunities that have been given us for studying the whole question, both in Europe and in America, have brought our information so well up to date that we should have no difficulty in taking in hand to give an object lesson on the Springburn route, of which the citizens will not be ashamed. Although the question of alternating currents for longer distances is at present occupying a good deal of attention, we need not enter upon it here, as direct current would, in any event, be used for a short distance like the route to Springburn. The estimate already given of the cost of equipping the Springburn section on the basis of the present service, apart from any necessary renewal of rails, is £19,575, as detailed in last report by the sub-committee on mechanical traction.

We therefore simply confirm the recommendation of the sub-committee as per their report on mechanical traction in Europe, dated July last, which reads as follows: "That, having carefully considered the whole question, we recommend that the route from Mitchell street to Springburn be equipped for overhead electric traction as indicated, and that with a view to providing in this way for the necessary augmentation of the service, which is sure to be required next spring, it be remitted to the tramways committee with powers to equip this route accordingly as soon as they conveniently can." And we make the further suggestion that the corporation remit to the electric lighting committee, acting in co-operation with the tramways committee, to light electrically as an experiment a portion of the route with a view to utilizing the traction poles for lighting purposes.

New Street Railway Scheme for the North Side.

Chicago does not suffer from a dearth of street railway projects, as new schemes are coming into view constantly. Some are presented to the public in good faith and others are—not. To which class the Chicago Electric Street Railway company belongs does not yet appear. It is said to be incorporated with a capital of $10,000,000 to build an electric line from Evanston to the Chicago River at Wabash avenue, and it is promised that passengers will be carried the whole distance for one five-cent fare. Such a road would be a competitor to the Yerkes lines, including the North Shore electric line, the North Chicago street railroad and the Northwestern elevated, as well as to the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul railroads. Within the city limits the company says it will use the underground electric system, and will agree to pay the city five per cent. of its gross receipts. The enterprise is said to be backed by Chicago capitalists, whose names will be withheld until the franchise is obtained. Money to the extent of $20,000, it is stated, already has been expended in preliminary expenses.

A Canard Exploded.

The statement that the capitalists interested in the Niagara Falls electrical transmission have secured control of the water power of the Chicago drainage canal, printed by the New York *World*, is emphatically denied by the trustees in charge of the work. Mr. Malette says: "There is no truth whatever in the story. When Mr. Hawley was in Chicago a few weeks ago the subject of using the water power of the canal was discussed, but only as a possibility. At that time Mr. Hawley understood that the board considered it too early to entertain any plans of the kind. I presume he has accidentally let a few remarks fall concerning the matter, and from these the story sprang, although it really has no foundation in fact."

The Edison Electric Illuminating company of New York reports gross earnings for November at $225,529, an increase of $33,491 as compared with the same month of last year, and net $123,883, an increase of $29,931. For the 11 months ended November 30th the gross earnings were $2,001,162, an increase of $214,423 compared with the corresponding period of last year, and net $961,091, an increase of $135,734; interest on bonds, $297,825, leaving a surplus of $663,266, an increase of $89,526.

The D. A. Kusel Telephone Apparatus.

The accompanying cuts illustrate the line of telephone equipment manufactured by the D. A. Kusel Telephone Manufacturing company of 1105 Pine street, St. Louis, Mo.

In Fig. 1 is shown the company's "20th century" telephone. This is fitted with a No. 0 extra high resistance magneto bell with lightning arrester switch, also a D. A. Kusel automatic receiver switch hook, a Kusel transmitter, with triple power induction coil and a No. 1 receiver and cord. It is mounted on highly polished black walnut backboard with double battery-box, all connected and ready to attach to line, and furnished with two Laclede wet batteries and lightning fuse-blocks. This telephone, it is claimed, will talk over a distance of 1,000 miles, and generator will ring 150 miles.

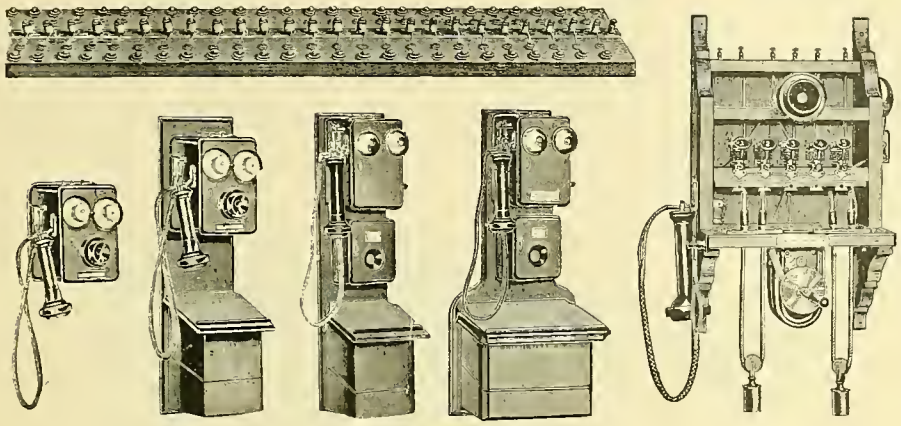


Fig. 4. Fig. 3. Fig. 2. Fig. 1. Fig. 5.

THE D. A. KUSEL TELEPHONE APPARATUS.

Fig. 2 shows the company's "No. 1" telephone which is fitted with a magneto bell with lightning arrester switch and a D. A. Kusel automatic receiver switch hook and transmitter, also one receiver and cord. It is mounted on a highly polished walnut backboard with a single battery-box, all connected and ready to attach to line. It is equipped with one Laclede wet battery. This instrument will talk, it is stated, over a distance of 250 miles and generator will ring 50 miles. This telephone is made for exchange work and county lines, and the company states it has over 5,000 in daily use and all giving perfect satisfaction.

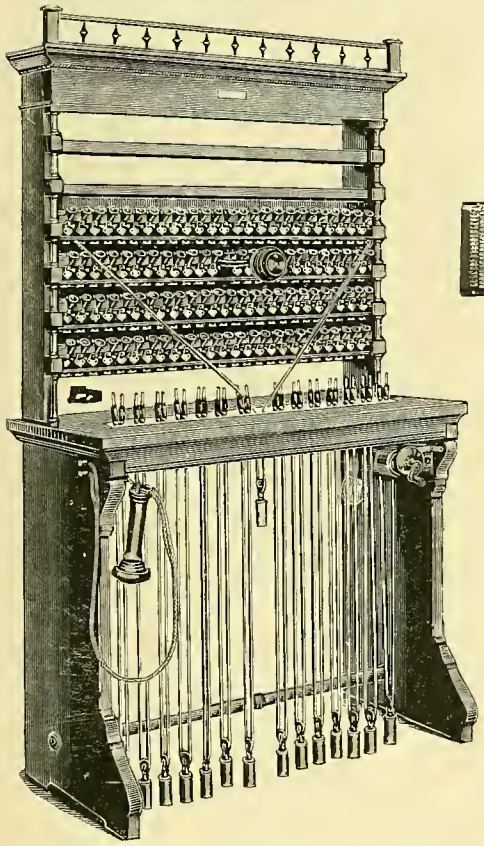


FIG. 6. THE D. A. KUSEL TELEPHONE APPARATUS.

The new "Special" telephone, Fig. 3, is composed of one magneto bell, with lightning arrester plug, one D. A. Kusel automatic receiver switch hook, one transmitter in hard rubber case, and one receiver and cord. It is mounted on a highly polished black walnut backboard, with single battery-box, all connected and ready to attach to line. It is furnished with one Laclede wet battery. This instrument is designed with the view of supplying the growing demand for a reliable telephone at a moderate price. The generator will ring over any line less than 10 miles in length, and the transmitter is guaranteed for 250 miles.

The D. A. Kusel "No. 3" telephone (Fig. 4) is composed of one magneto bell, one D. A. Kusel automatic receiver switch hook, one transmitter in hard rubber case, one Laclede wet or Mesco dry battery. This instrument is the same as the new "Special" without backboard. It can be fastened to the wall with two screws on the inside of bell box and the battery can be placed in any convenient out-of-the-way place. It may be used on small exchanges or private lines where a reliable telephone at a very low price is desired.

In Fig. 5 is shown one of the company's complete switchboards for central station toll system or small exchange. Switchboards are made in this style for any number of drops less than 50. This switchboard is furnished complete the same as the larger ones and has all the advantages possessed by the former. Increase shelves are left vacant whenever desired.

Over Figs. 1 to 4 is shown the company's lightning arrester, which is composed of small coils wound with very fine German silver wire on a hard rubber core. These coils are placed on a brass plate connected with the ground, and when lightning enters the coils it must travel through them and jump the ground escape before it can reach the switchboard. This is claimed to be almost impossible, and the company guarantees to rewind free of charge any coils on switchboard that are burnt out while its lightning arrester is in use.

H. W. J. PANEL CAR HEATER.

The most important piece of the company's apparatus is presented in Fig. 6, viz., the D. A. Kusel exchange switchboard. The one shown is of 100 drops with two empty shelves, allowing for an increase of 50 drops on the same cabinet. The points of superiority this switchboard is claimed to have over any other switchboard on the market are numerous. Every drop is composed of double pole magnets, so wound that the least turn of generator on telephone will drop the indicator; yet, each indicator is so securely locked that the strongest straight pull could not drop it—the direct downward pull of the magnet being the only manner of dropping the indicator. Plug holes are directly beneath each indicator, so that operator has only to look once, when call is made, and can plug in and raise indicator with one hand at the same time. This switchboard can be increased whenever desired, and cabinets will be furnished with room for 50, 75 or 100 increase without extra charge. It is so compact that one operator can easily attend to 300 drops—the entire space taken for 100 drops being only 15 by 30 inches. It has each drop perfectly distinct and free from all the others, and has no conglomeration of wires either in front or rear. It does not require an expert to set up and make connections. Each line wire can be connected with switchboard by simply inserting wire in binding post directly in the rear of the drop intended for it. It is simple in construction, has the finest mechanism, is rapid in connecting and may be operated by a boy or girl 15 years of age.

Relative to the company's organization it may be said that it is an equal partnership between D. A. Kusel and James S. Cuming. D. A. Kusel is 64 years of age and has been identified with the electrical manufacturing business for nearly 40 years, having in this time had practical experience in many branches of the electrical mechanism. In 1886 he started the manufacturing of telephones under the present firm name, and operated under the Pan telephone patents, but as time and practical experience suggested, improvements were made until the present standard of excellence was attained. The D. A. Kusel telephones are manufactured under letters patent No. 531,194 issued to D. A. Kusel and now owned by the firm.

In June, 1895, Mr. Kusel sold one-half interest to Jas. S. Cuming, who has charge of the business interests of the firm, while Mr. Kusel confines his entire attention to the factory. Mr. Cuming is a young man who commenced at the bottom round of the ladder in a large commercial house in St. Louis and by pluck and energy worked himself through the various positions in the house and at the age of 19 accepted a position as traveling salesman, which position he held until he entered the D. A. Kusel Telephone Manufacturing company as partner and business manager. Mr. Cuming's business experience has rapidly pushed the company to the position it deserved, having doubled the sales of the previous year and securing many new customers. The company recently removed from its old quarters at 22 North Second street to 1105 Pine street, and is now prepared to handle business in all sections of the United States.

H. W. J. Electric Car Heaters.

Two forms of "H. W. J." car heaters are shown by the cuts. The panel heater is 50 inches long, nine inches wide and seven-eighths inch thick, and when attached to the panel below the seat projects but 1¼ inches into the aisle. It therefore occupies no space which might interfere with the movement of the passengers and no mutilation of the woodwork is necessary for its installation. The upright heater has a cast-iron casing and is 10½ inches high, to admit of its use in cars with cross seats, and is 15 inches long and 2¼ inches thick.

The resistance wire in the heaters is covered with asbestos and woven into a mat, which is attached by an insulating compound to an asbestos back. The heater is waterproof and rendered strong and durable by an insulating compound which is baked in at a high temperature. As it is impossible for the wires to come in contact with each other, there can be no short-circuiting. Vibration is also prevented, as the wires are enclosed in a practically air-tight casing and are not liable to become affected by atmospheric changes or moisture.

H. W. J. UPRIGHT CAR HEATER.

The regulation of the heaters is effected by throwing on one or more of the two sections into which the resistance wires are divided. Three combinations are effected by the "H. W. J." regulating switch, which is substantial, compact and ornamental, so that it may be situated in any part of the car.

There is a large number of the "H. W. J." heaters in use on the various railroads of the country, and the manufacturing facilities of the H. W. Johns Manufacturing company have been taxed to the utmost during the present season.

From Hartford, Conn., and dated December 21st, a press dispatch gives this news: "Work was begun today to construct the third-rail electric system between this city and New Britain. Workmen were out to-day on the line of the New England road taking measurements preliminary to bonding the rails and laying the third rail. The removal of buildings that stand where the big power house is to be located in Berlin was started this morning. Electric cars will be running on the roadbed of the steam railroad by March 1st. The cars will be the same as those used at Nantasket Beach."

Overshiner Switchboard and Telephone.

About two years ago J. M. Overshiner of Elwood, Ind., became interested in the telephone exchange of his home city, which had been installed in opposition to the Bell interests at that place. Mr. Overshiner was practically the owner of the Elwood exchange, and in that capacity he soon became impressed with the fact that there was room for great improvement in telephonic

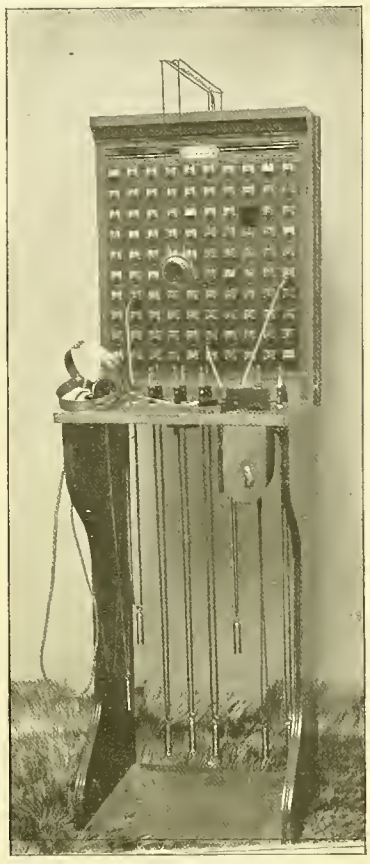


FIG. 1. OVERSHINER SWITCHBOARD AND TELEPHONE.

equipment, and being a thorough mechanic he set to work to design apparatus that would be an improvement over existing forms. It was at this time he decided to start an independent telephone manufacturing company, and how well this organization has succeeded in overcoming the defects in telephonic apparatus will be seen from the accompanying cuts.

Without going into details it may be said that the accompanying illustrations show the general features of the improved apparatus now being installed by the Elwood Telephone & Switchboard company. This concern has already to its credit, although it has worked most quietly, two successful exchanges, with others in prospect. The exchange at Elwood, Ind., is equipped with Overshiner apparatus, as is also an exchange of 400 subscribers at Marion, Ind.

A novel feature of the Overshiner apparatus will be clearly seen from the accompanying illustrations. Fig. 1 shows the company's 100 drop switchboard complete, but with one drop and all its connections removed. Figs. 2 and 3 show each an enlarged view of the self-contained drop, which will be noticed alongside the plugs also in Fig. 1, the drop being removed for the purpose of indicating the extreme simplicity of the mechanism.

The Elwood company claims its switchboard is one that does not infringe existing apparatus. A 100 drop board occupies 15 inches square. Each drop is complete in itself and with hard rubber front, and it can be removed and replaced without disturbing any other drop or any of its connections; also without unsoldering or soldering a single wire. The line wire is not even disturbed. Each drop, drop coil, ringing connection, drop restorer, are all in one and encased in a hard rubber shell. The act of answering a call (Figs. 2 and 3) mechanically restores the drop at the same time, the mere insertion of the plug doing the work. The action of making connection rings up party called for, and the operator cannot be "mixed up." A drop "down" is positive evidence that a call has not been answered. Any operator can take out and replace a drop and all its connections in 20 seconds, when it is ready for use. The round plugs and spring contacts make perfect connection. Fig. 2 shows complete drop with plug in the act of answering call and restoring drop. It is an impossibility to answer a call without restoring drop, an impossibility, too, to place plug in number called for without ringing it up. There are only two movements to answer call, restore drop and ring up person called for. No ringing back in operator's or subscriber's ear. Of course, along with the most essential apparatus the company furnishes a handsome and efficient subscribers' equipment.

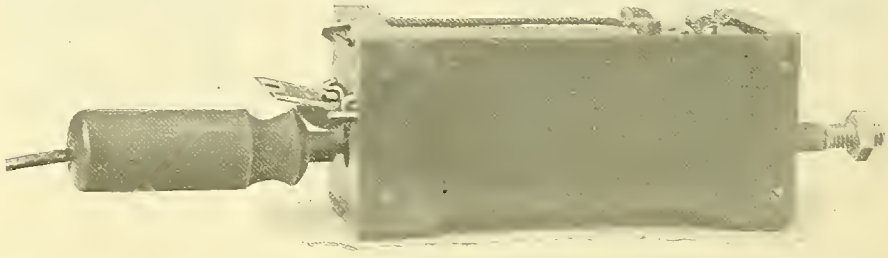


FIG. 2. OVERSHINER SWITCHBOARD AND TELEPHONE.

For the benefit of those who may not be familiar with the standing of the Elwood Telephone & Switchboard company, it may be said that J. M. Overshiner, in addition to his telephone manufacturing interest, is president of the Elwood water works, the Elwood Natural Gas & Oil company and the South Elwood Land company, and is also a director of the American Tin Plate Manufacturing company, which employs 1,800 men. General Manager E. P. Overshiner of the company is a son of J. M. Overshiner and is also owner of the Logansport Mutual Telephone company, operating an exchange in Logansport in opposition to the Bell interests at that point. A. V. Overshiner, a brother of the general manager, is secretary and treasurer of the Elwood Telephone & Switchboard company. This latter gentleman is now the owner of the Elwood telephone exchange, operating there in opposition to the Bell company. The Elwood company's factory is at Elwood, Ind.

Electrical Apparatus for Firemen Wanted.

United States Consul Germain, at Zurich, Switzerland, has informed the State Department at Washington that H. Schiess, chief of the Zurich fire department, desires to be put in communication with American manufacturers of firemen's portable electric lamps and other electrical appliances and supplies for the use of firemen. The consul advises the sending of catalogues and price-lists, printed preferably in German or French. As all the fire departments of Switzerland belong to the Union of Swiss Fire Departments, whatever new appliances the Zurich department purchase, would, if proven satisfactory, be followed by orders from the other fire departments of that country.

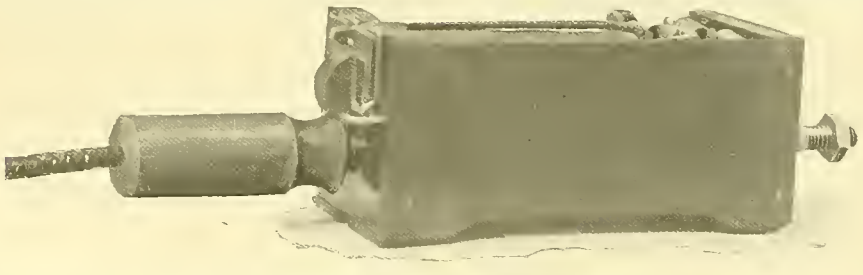


FIG. 3. OVERSHINER SWITCHBOARD AND TELEPHONE.

The annual banquet of the Western Society of Engineers will be given at the Technical Club, 228 Clark street, Chicago, at seven o'clock on the evening of January 5th.

The Persian Gulf Cable of 1864.[1]

By F. C. Webb.

Part I.

Thirty-two years ago! Thirty-two years seem a tremendous period in the history of submarine telegraph engineering! That most important branch of civil engineering only dates back to 1850, say 46 years ago. And yet, what has been done during those 46 years? North Sea, Irish Channel, Mediterranean, Red Sea, Atlantic North and South have been traversed by submarine cables; and, not content with that—not content with crossing channels, seas and oceans, where land lines could not possibly compete—submarine cables have beaten the land lines by ringing South America, Africa and several other continents with their audacious, full, black lines on the maps. But to carry out all these splendid works a generation of engineers and electricians has gradually been born and educated. I feel that they would and will scorn anything written by their "great-grandfather" on cable work generally, only perhaps they have never, with all their experience, laid 1,300 nautical miles of heavy telegraph cable from large sailing ships in tow. Therefore, I feel this—that though many may scorn what I write, yet others may learn; for they can never tell when it may again become cheaper to lay cables from sailing ships in tow, rather than from steamers. Time will show. Cables of hundreds, nay thousands, of miles in length have been laid since then in deeper water, under greater difficulties and more stringent conditions of supervision, without any mishap of any kind. In fact, since then (1864) the laying of cables has become to the public such a matter of humdrum engineering that the process seems almost classed with the laying of the permanent way on a railway, the cuttings and embankments and tunnels of which have been already prepared, or, we will say, the making of a macadamized road in the suburbs of London. Who cares about a submarine cable being laid from Europe or Africa to America? A brief paragraph appears in a morning paper, and announces that a telegraph cable has been laid, say from Africa to South America; scarcely anybody takes the slightest notice of or feels a particle of interest in the subject. The shareholders, perhaps, watch the price of the shares; the directors watch the reports of their engineers and contractors, and, if all goes well with the cable, engineers, certifying electricians, contractors, directors, shareholders, the press and the stock exchange, another cable is soon suggested by an engineer, projected by a director, endorsed by a contractor; an additional line in due time appears in the maps across the northern or southern hemisphere (as the case may be), with a certain amount of profit to the contractor and a more or less certain profit to others. But during these various operations the energetic engineers and electricians of the contractors see at every expedition some improvement that can be made in the general machinery for paying out, etc., including the important part of buoyage and moorage of buoys, and the electricians foresee what can be improved in the "shore-to-ship" testing arrangements. Again, the eagle-eyed and conscientious engineers and electricians who act on the part of what may be termed the buying side—that is to say, the companies for whom the cable is to be laid—are constantly discussing, inventing and scheming every possible honest way that may enable them to prevent even the fraction of an ohm of insulating resistance per "knot" (O! how I hate that word!) passing where it ought or ought not to be, or the hundredth part of a degree Centigrade of temperature being allowed one way or the other, whether "in the tanks," or "on board ship," or at the bottom of the deep blue sea after one month, as to the resistance of the copper or the gutta-percha, without any remonstrances to the contracting company.

With this preamble I will start right away to describe the laying of the Persian Gulf cable in 1864. For the political and engineering reasons for laying the cable from Kurrachee to Fao I must refer readers of the *Electrician* to the issue of July 9, 1886. It had been decided on by the British government, on the advice of the Indian government, to lay a heavy cable from Kurrachee, the western terminus of the Indian land telegraph lines, to a place called Fao, a miserable little village on the banks of the Shat-el-Aral (River of the Arabs), which river is the result of the confluence of the sacred and historic rivers, the Euphrates and the Tigris, 50 miles above Fao. The cable was to touch at Gwadur, on the Mekran coast, then at Mussendom, on the Arabian coast, from thence to Bushire, the seaport of Persia, and then finally on to Fao.

The Indian government entrusted Major Patrick Stewart, R. E., with practically a *carte blanche* to carry out the whole work. He was previously a very distinguished officer in the Bengal engineers, who had carried the land lines on poles from the rear to the front as the

1. From the London *Electrician*.

army advanced to the relief of Lucknow, and this at times under round shot fire from the mutineers. Colonel Stewart engaged Sir Charles Bright and Latimer Clark, then in partnership, as engineers for the Indian government, and decided not to give the making and laying of the cable to any one single firm, but to have the cable made and the government to lay it at their own risk.

The gutta-percha-covered conductor was ordered from the Gutta-percha company in Wharf road, and W. T. Henley obtained the contract for covering it with serving, iron wires and the "Bright and Clark" serving and compound. The conductor was 225 pounds per nautical mile, with three coatings of gutta-percha with Chatterton's compound, weighing 275 pounds. The conductor was made on a pattern suggested by L. Clark, which was supposed to fulfill the conditions of a strand with the smaller surface of a circular conductor. It was formed of five sections, four in the form of a quadrant in section, held together by the fifth, which had the section of a ring: in fact, a tube. The lengths of about 4,000 yards were tested in tanks at the Gutta-percha Works for insulation at a temperature of 24° C., and gave about 230 millions of Siemens units per knot. A serving of soft yarn, untarred, followed, and 12 No. 7 galvanized iron wires formed the sheath, which was again protected by two layers of hemp, pitch, lime and silicon. The completed cable weighed 3.75 tons per nautical mile.

The government chartered four sailing ships, as follows: The Marion Moore, 1,036 tons; the Kirkham (iron), 1,061 tons; the Tweed (formerly the Punjaub, paddle-wheel frigate, but converted into a sailing ship), 1,744 tons; the Assaye (also formerly a paddle frigate, but converted to a sailing ship), 1,528 tons, and the Cospatrick, 1,199 tons.

The government also bought the screw steamer Charente, of 441 tons, and rechristened her the Amberwitch. This vessel was fitted with tanks, bow and stern sheaves, picking-up machine and paying-out gear; and the sailing ships were fitted each with three tanks, stern sheaves and paying-out gear. Newall's cones and rings were used. The cones were of wood, and the rings of gas pipe, with radial arms and pieces of pipe clasping the arms near the ring, and passing through holes in the deck and castings on the deck above. These castings had clamp-screws, so that when the rings were lowered the straight pieces could be clamped into that positon to prevent the ring being thrust upward by the cable when paying out, which it was likely to do when the outer coating of the cable caused it to stick to the flake below. The paying-out drums were all overhanging, as was that of the picking-up machine on the Amberwitch. This had internal spur gearing, and a knife fitted to the afterpart that could be allowed to fall down, by pulling out a large cotter, in order to allow the turns of cable to be taken off the drum. This was, I believe, the first example of an overhanging picking-up drum, or of internal spur gearing on the drum itself. By this arrangement no strain came on the spokes of the drum and no torsion on the shaft that carried the drum.

The cable was hauled on board the ships off W. T. Henley's works, two ships at a time being loaded in some cases. When all the cable was on board each ship she was towed into the Victoria docks, and three-inch decking laid on sleepers over the coils. The decking was caulked. Each ship was fitted with a centrifugal pump, worked by a small engine, in order to pump up the tanks from time to time after it had become necessary to run the water off to change it. The ships left the Victoria docks in the following order: The Marion Moore, August 15, 1863, with 174.92 nautical miles of deep-sea cable, E. Donovan in charge of the cable; the Kirkham, September 13, 1863, with 181.25 nautical miles of deep sea and 6.34 nautical miles of shore end, Mr. Walker in charge; the Assaye, with 367.98 nautical miles of deep sea, J. T. Woods in charge; the Amberwitch, with 12.5 nautical miles of shore ends and tapers, Lieut. Arthur Stiffe, I. N., in command, on October 21, 1863; the Tweed, with 347.53 nautical miles of deep sea on October 24, 1863, Mr. Mosley in charge; the Cospatrick, with 103.15 nautical miles of deep sea and 23 nautical miles of shore end and 12 nautical miles of double shore end (that is, with two conductors for Bushire). I have not the date when this ship left. This ship had also five separate mile lengths of experimental cables of different types by different manufacturers and patentees, to be laid and tested in the Persian Gulf, and where eventually laid, tested and reported on by me in 1865. The total length of cable shipped was therefore 1,228.27 nautical miles, excluding the lengths of experimental cable. The ships arrived at Bombay in the following order: Marion Moore, December 22, 1863; Kirkham, January 13, 1864; Tweed, February 6, 1864; Assaye, February 12, 1864; Amberwitch, March 2, 1864; Cospatrick, April 16, 1864.

As soon as the Marion Moore and Kirkham had arrived the decking was removed from the coils, and the paying-out machinery, which had been stowed below for the voyage round the Cape, was re-erected. On January 21st the Indian government corvette Coromandel, having on board Col. Stewart, his brother, Capt. Stewart, Sir C. Bright, Dr. Esselbach and A. Brasher, left Bombay for Gwadur; and the same evening the Kirkham, in tow of the Zenobia, paddle frigate, and the Marion Moore, in tow of the Semiramis, paddle frigate, also left.

The ships arrived at Gwadur January 29th, and were met by the Victoria and the Clyde, gunboats. The Kirkham's cable had to be laid first, as she had on board the shore end for Gwadur. It was found she could not approach nearer than three miles to the landing-place. To land the shore end from boats would have been difficult; the Clyde was therefore used, her heavy gun being shifted from the after deck to forward, and the cable coiled where the gun had been. For a brake the "holding-back gear" of the Marion Moore's paying-out gear, consisting of a V-sheave and brake, with jockey-pulley, was used, and answered very well. Two miles of cable were coiled into the Clyde, and half a mile into each of the Zenobia's paddle-box boats. The end being landed, and all the shore-testing arrangements made under the supervision of Mr. J. Laws, the electrician, and his assistant, Mr. F. Lambert, paying out commenced, the Kirkham being in tow of the Zenobia, in command of Lieut. Carpendale, I. N. Of course, as the motive power was not in the cable ship, it was impossible to stop as quickly as in a steamer, where the engines can be reversed. To signal to the towing ship we used a white hand-flag for "go ahead," a blue one for "ease her," and a red one for "stop her," and at night the same colors with lanterns. It was also necessary to be able to converse, and this we did by (Morse) dot and dash; at night by a lantern with shutter, which was kept closed by an elastic band and opened by means of a handle. This was suggested by Mr. Walker, one of our staff. For the day an arrangement was constructed by which, when pressing a handle, a white dot about six inches in diameter appeared on a blackboard. The Morse alphabet was thus possible by day and night. We had telegraph operators on board the Zenobia as well as in the cable ship. The system answered very well, and was soon taken up by the officers of the men-of-war, who soon learnt to "read" and "send," and at one time in Gwadur East Bay the Assaye, Zenobia and Amberwitch were constantly flashing signals between them at night, thus saving a lot of work in sending away boats. I believe this is about the first time that the dot and dash Morse was used for signaling at sea. I should be glad to hear whether this can be contradicted.

We payed out at first at about 4.75 knots per hour. At 5 A. M. of February 5th we changed from fore to after hold. To do this safely we rehearsed. When there were only three or four flakes of cable left in the tank we stopped the towing ship and counted the turns of cable which ran out by the time the ship entirely lost her way. It was very tedious and very curious. Then going on again we stopped when a similar length of cable was left in the hold, which allowed the cable to slowly pay out until it was perfectly taut and could be handled for the change. This plan answered very well, and was adopted on every change of hold throughout the expedition. On the 6th, at 11 A. M., we had payed out all the cable but about half a mile from the Kirkham, and the Marion Moore was anchored on our beam. The end of the cable that we had laid was then passed (by means of hawser and boats) to the stern sheave of the Marion Moore, and then spliced on to the cable in the Marion Moore's fore tank. It took till the 7th to transship the men, telegraph instruments, and various ropes and apparatus. At 9:45 A. M. of the 8th we anchored off Ras Jask, and started paying out at 6:30 P. M., so as to make the land near Malcolm's inlet, on the Arabian coast, by daylight of the 9th. We anchored in this magnificent harbor at about noon of the 9th.

I suppose that some day, say two or three hundred years hence, civilization will spread to the coast of Arabia. When it does, let us hope that the British government will seize on this magnificent harbor, and its twin brother or sister, called Elphinstone inlet. The time must come. We invade Africa on every side, but Arabia seems to hold its own and remain impenetrable.

We landed the cable. We had laid altogether 361.83 nautical miles of cable; but it was not until February 13th that we finally landed the end, with a salute from the guns of the Zenobia. Then we (Mr. Laws, self, and staff) returned on board the Marion Moore in tow of the Zenobia to Bombay.

On the passage we each had an unpatented log of our own invention, some electrical and some mechanical; but we each watched our own children, and we were very jealous of any interference with our own particular child.

To be on board a large sailing ship in tow of a man-of-war is the most extraordinary situation I have ever been in. Nobody on board is responsible for anything. The captain of the ship you are in feels, after bringing his ship safely round the Cape of Good Hope, he has done his duty, and now, finding his ship in tow of a government ship which is thoroughly responsible, and a safe party to pay for damages if anything wrong occurs, feels a lightness of heart that is absolutely indescribable. He improvises concerts and all manner of entertainments. You glide along. There is no screw or paddle thrashing or pounding away. I don't know which I hate or love the most, the irregular *pum pum* of the paddle, or the monotonous but more regular *hum pum pum* of the screw. Your readers will understand that it is not a usual situation to be without sound of paddle or screw or any shouts of "hard-a-starboard" or "port," or "steady," or "stand by" here or there, or "let go" this or "hold on" that. Yachts are not in it. Even in a sailing yacht there must be something going on on deck; something must be let go, and the slack rope falls in a lump just over your head on the deck, within a foot of your nose, just as you hope to get a wink of sleep. Or they "go about," and begin shifting ballast. But to be in tow of one of Her Majesty's Indian government ships is the most tranquil manner of gliding through or over the Indian Ocean. Having given your readers some idea of the laying of cables from sailing ships in tow, it will be of very little interest to describe the laying of the cable from Elphinstone inlet (where there is another magnificent harbor) to Bushire, from the ships Tweed and Assaye, as the operation was a repetition of the laying of the Gwadur-Mussendom section. The two harbors mentioned are separated by a narrow isthmus, across which a land line was laid, and from the shore of the isthmus in Elphinstone inlet a short piece of cable was laid to a small island in the inlet itself, on which the station was to be built, but which had to consist of tents, etc., for the present. Two old 10 gun brigs were moored on either side of the island to protect the station in case of any attack from the Arabs. The Tweed payed out from the island towards Bushire until all her cable was out, when we anchored and awaited the arrival of the Assaye in tow of the Semiramis. This splice was about 32 miles from Bushire. At Bushire the Amberwitch was employed to land the end of the ordinary deep-sea cables; the double shore end, with two tapers, intended for the end shore here, being in the Cospatrick, which had not arrived. This was afterward laid by me from the Amberwitch, and the other cable cut out and picked up. We landed the end of the Bushire-Fao section from the Assaye and payed out toward the landing place near Fao. When about nine miles from the landing place the Assaye was anchored. And then Mr. Laws reported a want of continuity, 92.5 nautical miles from end in Assaye. This we repaired in the Amberwitch, and the fault proved a clean fracture through the whole five parts, just as if it had been a solid conductor. No doubt the two ends had been in contact until the conductor shrank when immersed for some hours in the colder water at the bottom of the sea.

CORRESPONDENCE.

New York Notes.

NEW YORK, December 26.—The principal electrical news of Christmas week is the determination which seems to have been arrived at by the Metropolitan Street Railway company to equip the Fourth and Sixth avenue lines with the trolley conduit system. The *Sun* is authority for the statement that after a conference that lasted two days, during which the estimates and plans of the company's engineer were considered, the directors of the company authorized President Vreeland on Tuesday afternoon to execute contracts for the equipment of the Fourth and Sixth avenue lines with the underground trolley system. Work will be begun as early as possible in the spring, and it is hoped that it will be finished before the end of next year. It is difficult to obtain official confirmation of this statement, but it is very possibly true. If it is, it will be seen that the Metropolitan company considers that there is a good explanation for the delay to traffic, occasioned by the big storm, on the Lenox and Lexington avenue electric conduit lines, of which I wrote you last week. The reported action also indicates that practical street railway people are still chary of the compressed-air system.

The Reno inclined elevator or moving stairway, which is electrically operated, was put into experimental use on Brooklyn bridge for half an hour or so on Thursday and it proved to be successful. It is the small experimental machine which was operated for two weeks last summer at Coney Island. In that time it carried 75,000 persons or more without accident. This machine is built for making a lift of only about seven feet, and as this is only about one-half the height of a bridge story, the place chosen for its operation is that farthest to the eastward on the right-hand side of the lower floor of the bridge entrance. The bridge officials were pleased at the result of the test. Mr. Reno expects to have the device all ready to run publicly on Monday. The electric motor which operates it stands under the stairway. This operates the moving platform by means of a worm gearing. A controller box, from which the movements of the motor can be regulated, is placed against a wall just to the right of the stairway, and a man will be stationed there at all times when the stairway is moving, with his hand on the regulating lever and his eyes on the passengers to prevent accidents.

Trolley car No. 4 of the National Express company in Brooklyn caught fire from an over-heated stove on Tuesday morning at Driggs avenue and South Ninth street. John Roberts and Edward Loveday, respectively motorman and conductor, after a vain attempt to put out the blaze, summoned the fire department. Almost the entire car was in flames when the firemen arrived. The car was damaged to the extent of $100 and the freight $200. The freight was mostly Christmas packages.

Among the recent improvements in the New York Orthopædic Hospital is a complete outfit for making sciagraphs, which has been placed in a small room on the first floor. An entire new electrical plant has been put in to operate this apparatus and to furnish a current for lighting. An operating table will be placed in one corner of the room, and the apparatus will be used for examining the deformities of the patients and for picturing them to facilitate their treatment. Arrangements

will be made by which physicians generally may have the use of this apparatus and room at certain hours. In the particular line of surgery to which this institution is devoted it can be readily seen that the X-ray pictures and fluoroscopic examination will be of the utmost advantage.

The death of Harvey L. Lufkin, the manager of the Crocker-Wheeler company, on Monday, has occasioned sincere regret to the electrical fraternity. Mr. Lufkin, who was in his fortieth year, underwent an operation for appendicitis at Mt. Sinai Hospital and died soon after. He had been with the Crocker-Wheeler Electric company for four years, and for the last 15 years had been interested in electrical pursuits, having been associated with Messrs. Wheeler and Crocker, in the C. & C. company, as far back as 1886. Mr. Lufkin was a thorough electrical man and an agreeable gentleman. His untimely death is a severe blow to his widow and to his friends. M. S.

Northwestern Notations.

MINNEAPOLIS, December 26.—Henry Stenz and George Westerman of Faribault, Minn., are introducing a patent globe for arc lights, which, it is claimed, will do away with the shadows cast by the side rods in the present style of lamp. This new device consists of enclosing the light in a circle or oval composed of small glass rods; it diffuses the light evenly and, it is claimed, increase the effective candle power greatly. The globe is being tried in St. Paul.

The council of Great Falls, Mont., has made a proposition to the lighting company to pay $8.33 per light per month for 42 arc lights and says that if the company does not accept this no other offer will be made.

Mrs. M. I. Clark has purchased the interest of T. S. Roberts in the electric light plant at Mason City, Ia., and assumes entire control of the company.

F. J. Melounek has made a proposition to the council of New Prague, Minn., to put in an electric light plant if the city will contract for street lighting.

The city of Negaunee, Mich., has awarded the contract for furnishing boilers, engines, etc. for a municipal plant to the Arbuckle-Ryan company, of Toledo, and for the electric equipment to the Ft. Wayne Electric corporation. These firms secured the contracts once before, but they were canceled because the construction of a plant had not been voted on. There were two lower bidders on the second competition. Work has been begun on the plant. Steps have been taken to prevent the completion of the contract, by injunction.

After being postponed a number of times, the sale of the assets of the Central Wisconsin Electric Railway company of Oshkosh, Wis., by the sheriff, has taken place. The franchises were sold to W. H. Clark of Chicago for $551; the rails and iron to Chas. Barber for $1,900; the ties and poles to W. F. Gruenwald for $600, and the claim of the company against the city for the $5,000 guarantee deposit to Chas. Barber for $25. The purchasers of the franchise have made a proposition to complete the road for a bonus of $25,000, and an attempt is being made to raise it. The Citizens' Traction company has been incorporated to finish the road.

The Albert Lea Electric company of Albert Lea, Minn., has just completed remodeling its plant and gave a banquet to the leading citizens of the place. During the event the president of the company took occasion to deliver a "roast" on the editor of the *Standard*, who was present, for his attacks on the company. This paper has contended for a municipal plant rather vigorously and complained of the inefficient service which the company has heretofore been giving. The editor was present by invitation, and those present were divided in their opinions whether to side with the company or the attacked newspaper man. This company has just increased its capital stock to $100,000.

A committee of the St. Paul Chamber of Commerce appointed to consider fire insurance rates and kindred matters reported that in many cases buildings had been rewired and reductions in rates secured. "Most of the electric wiring in this city is very defective," comments the committee, "owing to the fact that they had no inspector of standing to oversee the construction of such work. This matter is now receiving the attention of the council, and it is expected an appointment will soon be made."

In Mitchell, S. D., the patrons are warned when the lights are to be turned off in the evening by one long and two short blasts on the whistle and the same is used 15 minutes before midnight when the lights are shut off. In Preston, Minn., the electrician dims the lights five minutes before closing time as a warning. They close at 11:30 P. M.

The water power electric plant at Des Moines, Iowa, was sold at sheriff's sale to the General Electric & Construction company for $83,000. The city is about to put in a municipal plant.

An attempt is being made at Huron, S. D., to lease the Risdon artesian well, which has a pressure of 150 pounds to the square inch, to operate an electric light plant and for other purposes.

Hudson, Ia., is agitating for an electric line to Waterloo.

The council of Beatrice, Neb., has granted a franchise to the Heat, Light & Power company, which is to have a plant in operation by May 1, 1897.

The General Electric company has submitted a proposition to the Minneapolis City Council for street lighting, notwithstanding the fact that there is a contract for five years.

Electric lighting is being considered by Zumbrota, Minn., citizens.

The loss on the Hastings, Minn., electric light plant has been adjusted and the work of rebuilding the plant begun.

A difference over the payment of a bill between the Davenport Power & Light company and the city of Davenport, Iowa, resulted in the company cutting the wire supplying light to the city hall. A threat to do so was made and the city officials secured an injunction, and in the meantime placed a watch along the streets to prevent the wire being cut before it could be served. An employe of the company evaded the watch at the rear of the city hall and cut the wire at about the same time the injunction was being served at the office of the company. The man was arrested but was released as there was no charge on which he could be held. The matter was patched up for the time being and the light restored after being off for about 90 minutes.

The city of Mt. Pleasant, Iowa, has been sued by the Fort Wayne Electric corporation for $2,000 damages for breaking a contract to take an electric light plant, which the company had constructed under the contract. The Sioux City Engine & Iron Works will probably bring a similar action on the contract for engines. The city made the contracts with these companies, but they were held illegal by the courts because the matter had not been submitted to popular vote. This was done and the proposition defeated.

The electric light company and the street railway company of Muscatine, Iowa, have recently effected a consolidation. Having thus shut out the competition which has heretofore kept down prices for lighting, the new company has advanced prices $2 per month and merchants are vainly protesting.

Residents of Merriam Park, a suburb of St. Paul, have petitioned the council to compel the street railway company to replace the present Selby avenue cable with electric power. The company would have done so long since but for a very steep grade, encountered on the line, which is thought to be too heavy for electric power to overcome. It has been suggested to tunnel the hill, but for a number of reasons that has not been considered feasible. The plan is now put forward to go around the hill by a rather circuitous route, which would avoid the extreme grade.

The Northern Pacific Railway company is preparing to erect a power house at Tacoma, Wash., to operate its coal bunkers and furnish light for its buildings.

The city of Mt. Vernon, Ia., has granted a franchise for electric lighting to the Mt. Vernon Electric Light company.

It has been rumored that the Edison Electric company is about to bring suit against a number of the smaller dealers in electrical goods in Minneapolis. It is claimed by this company that these dealers have been infringing upon the Edison three-wire patent, and they will be compelled to defend themselves in court. No papers have as yet been filed, but it is expected that they will be at an early date. C.

Washington, D. C.

WASHINGTON, December 26.—The fight between the Eckington & Soldiers' Home and Belt Railway companies and Congress still continues. It is almost the unanimous opinion of residents of Washington that such a state of affairs would not be tolerated in any other city of the Union. The latest move is the bill introduced by Mr. Gettinger of New Hampshire, providing for the trial of one or more compressed-air motors on each of the above-mentioned roads within 60 days after the passage of the act, and that if, after a two months' test, the motors should prove satisfactory, the District Commissioners are empowered to grant a permit for the complete equipment of the road, which must be accomplished within six months. In case the motors do not prove satisfactory, the roads must be fully equipped with an underground electric system within 18 months. This is regarded as the strictest bill introduced yet relative to these roads, as it provides that in case of failure to comply with the provisions of the bill the attorney-general of the United States in the Supreme Court of the District of Columbia shall enforce the forfeiture of their respective charters, and that from the decision of this court there shall be no appeal.

Mr. Henderson of Iowa, from the committee on rules, introduced a resolution providing that on Thursday, January 7, 1897, immediately after the reading of the journal, the House shall resolve itself into a committee of the whole House on the state of the Union for the consideration of the House bill entitled: "A Bill to Amend an Act Entitled 'An Act to Aid in the Construction of a Railroad and Telegraph Line from the Missouri River to the Pacific Ocean, and to Secure to the Government the Use of the Same for Postal, Military and Other Purposes,'" etc. The amendment concerns the settlement of some bills, etc.

Mr. Hill of New York (for Mr. Brice of Ohio) introduced a joint resolution providing that the secretary of the Smithsonian Institution be authorized and directed to participate in the Exposition of Gas Apparatus and Appliances, to be held at Madison Square Garden, New York, from January 27 to February 6, 1897.

The three-cornered fight between the United States Electric Light company, the Potomac Light & Power company and Congress has taken a new turn. Mr. Cockrell of Texas has introduced an amendment to Resolution 345, submitted by Mr. Gettinger of New Hampshire, December 17th, providing that as the Senate and House are now investigating the question of laying subways in the streets, alleys, etc., of Washington, and the commissioners have recently entered into a contract with the Potomac company for the lighting of certain public parks and streets in the District of Columbia which involves the opening of several miles of streets for the purpose of laying conduits, that, pending the result of the Congressional investigation of the subject, the commissioners are requested not to permit the Potomac company to open any streets, roads, parks or alleys until some definite action is taken by Congress regarding the matter, and further that in view of the possible crowded condition of the city during the inauguration the commissioners and the superintendent of public buildings and grounds are requested to permit the United States company to erect temporary poles to string electric wires, provided, in view of privileges heretofore conferred on it by Congress, it will do the lighting (that was contracted for by the Potomac company) free of charge until action is taken by Congress or the contract with the Potomac company shall expire, on June 30, 1897. The commissioners are further requested to issue permits to the United States company for such other lighting as they may deem necessary, provided it is done free of charge, the company to remove also at its own expense the wires and poles from the streets when requested to do so by the commissioners.

T. I. P.

Pattern Letters and Figures.

The largest and best line of metallic and brass pattern letters and figures is made by H. W. Knight & Son, 192 State street, Seneca Falls, N. Y. Address them for catalogue.

PERSONAL.

Prof. R. B. Owens of the University of Nebraska, Lincoln, Neb., spent his holiday vacation in Chicago.

Homer A. Waddell, of Scottdale, Pa., who is well known among independent telephone men, was married to Miss Gertrude Thompson of Indiana, Pa., on December 31st.

After serving for two years as secretary and treasurer of the Missouri Telephone Manufacturing company of St. Louis, I. J. Kusel has been advanced to the position of president. His friends are congratulating him.

J. F. Outwater, who has been representing Hugo Reisinger of 38 Beaver street, New York, will resign his position to return to the Edison Electric Illuminating company of Brooklyn, with which he formerly was connected for eight years. Mr. Outwater leaves Mr. Reisinger with the latter's best wishes for success in his new and important position as purchasing agent.

ELECTRIC LIGHTING.

The Chicago Edison company has purchased the property occupied by its Market street plant from Jacob Rehm for $252,000.

In discussing the question of protection for the treasures of the capitol at Washington, a local paper says: During the past summer an improvement in the lighting of the capitol was made which is looked upon as really adding 100 per cent. to the police and watch force of that building and surrounding grounds. An electric light plant was introduced in the building, and now not only are the corridors, radiating in all directions through the great structure, brilliantly lighted, but the grounds are illuminated almost as thoroughly as is Pennsylvania avenue. Pedestrians crossing the grounds at night no longer have cold chills creeping along their spinal cords as they plod along under the shadow of overhanging trees. The knock-downs that have occasionally occurred in that park are not likely to be repeated in the future, as light makes cowards of footpads.

TELEGRAPH.

The Minneapolis fire department has substituted a set of telegraph instruments for the telephone system between the different engine houses. It is experimental, but is expected to be an improvement over telephone connection.

Judge Lacombe of the United States Circuit Court in New York has handed down a decision denying the motion for a preliminary injunction in the suit of the United States against La Compagnie Francaise des Cables Telegraphiques, the United States & Hayti Telegraph & Cable company and the United States & Hayti Cable company. The suit was brought by United States District Attorney Macfarlane to prevent the laying of the United States & Hayti cable between this country and Hayti, and its landing at Coney Island, without the consent of the government of the United States. A motion was made for a preliminary injunction on a bill of complaint and affidavits. In his decision Judge Lacombe says: "The summary granting of a preliminary injunction is appropriate to a state of facts which presents some elements of immediate necessity. There is none here. The laying of the cable was completed before this motion was submitted, and there is nothing to show that its operation, until final hearing, will produce irreparable injury to the United States or to any individual. It is thought that without the consent of the general government no one, alien or native, has any right to establish a physical connection between the shores of this country and that of any foreign nation. Such consent may be implied as well as expressed, and whether it shall be granted or refused is a political question which, in the absence of Congressional action, would seem to fall within the province of the executive to decide. It is further thought that the executive may effectually enforce its decision without the aid of the courts, and it is certainly indisputable that Congress has absolute authority over the subject. That body is now in session, and if any urgent necessity, not disclosed in the papers before the court, should call for immediate action, it can settle the question of assent or non-assent with such definiteness as to leave no further room for argument."

MISCELLANEOUS.

George Cutter will give a practical talk on "Heating by Electricity" before the Chicago School of Electricity, 335 Dearborn street, on January 7th, at 8 P. M.

The annual convention of the National Association of Manufacturers will be held in Philadelphia on January 26th to 28th. The tariff and its relation to business will be discussed. The executive committee extends a cordial invitation to all manufacturers of the United States, members or non-members, to attend this convention. Those holding certificates of membership will be entitled to the privileges of debate and voting.

A sciagraph showing a man's skull with an imbedded bullet provided valuable testimony in Justice Kehoe's court at the Desplaines street police station in Chicago last week. Frank Dugan, 363 Park avenue, was the defendant. The charge was preferred against him by Thomas Taylor, 281 Walnut street, of assault with intent to kill. Assistant City Prosecuting Attorney J. E. Ingram introduced W. C. Fuchs, who said he had taken a sciagraph of Taylor's head a few days after the alleged shooting took place, and had discovered the bullet near the left temple. The picture, showing a full-sized head of Taylor, was then shown to the court. The features of Taylor are visible, and a round black spot marks the place in the man's head where the bullet now lies. Justice Kehoe, at the suggestion of Prosecutor Ingram, allowed the introduction of the sciagraph as evidence. The attorney representing Dugan was taken so by surprise at the introduction of the picture by Prosecutor Ingram that he agreed readily to a continuance when it was suggested by Justice Kehoe.

TRADE NEWS.

The calendar of the St. Louis Electrical Supply company of 911 Market street, St. Louis, is a very attractive one. It is a chromo-lithograph of a beautiful young woman, and the coloring is particularly good.

Meyer & Domke have secured the contract and begun work for the erection of a power house and car house for the Winnebago Construction company at Oshkosh, Wis., which proposes to carry out the projects of the defunct Central Wisconsin Electric Railway company.

The Frank B. Rae Engineering company of 910 Fort Dearborn building, Chicago, has been incorporated to do a general engineering business. The engineers are Frank B. Rae, E. E., Frank G. Ewald, C. E., and Herbert McNulta, M. E. They will make a specialty of municipal lighting plants and water-works systems.

Of the ingenious advertising novelties invented or discovered by the American Electrical Works of Providence, R. I., there is no end. The latest is a happy Christmas conceit in the shape of an appetizing-looking plum pudding fastened to a holly-decorated card for mailing. On cutting the pudding-string felicitous words of holiday cheer become apparent.

The Missouri Telephone Manufacturing company of St. Louis has built an addition to its building at 917 and 919 Market street, to get additional room, although it only moved into the new quarters a year ago. Business is reported to be very good. This company manufactures all the parts of its instruments and promises that its 1897 catalogue shall be the most complete telephone catalogue ever issued.

J. P. Johnston, for some years with the Babcock & Wilcox company in its main office and later salesman in its Pittsburg office, will take charge of the Cleveland office for the Cahall sales department for the sale of Cahall vertical and Cahall-Babcock & Wilcox boilers, manufactured by the Aultman & Taylor Machinery company at Mansfield, O. The change took effect on the first of the year.

The Espersen revolving shade lamp, invented and patented by A. F. Espersen of the Pacific Electric company of La Crosse, Wis., has been put to a new use. One of the shades is in use on the desk of Charles Gibbons, city editor of the Victoria, B. C., *Colonist*. His window commands a view of Victoria's outer harbor, a mile away. Some time ago H. M. S. Nymphe was in the harbor practicing with her searchlight. Mr. Gibbons, who is a telegraph operator, turned up his shade and flashed a message to the Nymphe. It was seen and replied to and a long conversation of flashes in the Morse alphabet followed. The Pacific company is now locating agents throughout the United States and Canada, and those who desire to handle these powerful lamps will do well to communicate with it at an early date.

The Interior Conduit & Insulation company of New York announces that it has placed upon the market a new and improved iron armored insulating conduit. This conduit is a development of this company's well-known iron armored conduit which has met with such success during the last few years. The results attained in iron armored conduit as manufactured by the above company, while being far in advance of any other method of wiring, have nevertheless indicated certain lines wherein this product could be improved to more efficiently fulfill its functions. To attain this end the company has bent its best endeavors during the last few months to obtain a better article and at the same time one which could be produced at a lower price, and thereby assist in cheapening the cost of first-class electrical work. This conduit is claimed to be far superior to any ever placed upon the market, possessing advantages in that it is extremely light, has a smaller outside diameter for a given internal diameter, and, moreover, has greatly increased insulating properties. The insulating lining, being of a flexible nature, is not affected by bending, and the insulation under such conditions is not impaired. It will, it is said, withstand a temperature of 175 degrees Fahrenheit without becoming in any way softened or "tacky;" the company also claims that any 10 foot section will show an insulation of 11 megohms after being filled with water for 10 days. This new product has met with prompt recognition by the trade at large, and the Interior Conduit & Insulation company has still further enhanced the value of its well-known system of electric wiring.

BUSINESS.

Perhaps there is no incandescent lamp on the market giving better all-round satisfaction than the "Metropolitan" lamp, made by the Metropolitan Electric company of Chicago, which reports continued large sales, notwithstanding that trade in general is rather quiet.

The Electric Appliance company reports a daily increase in "Armorite" sales, and is more and more pleased by the way the trade seems to appreciate its efforts to give a superior article in the line of an iron-armored conduit. The demand increases, and, it is said, everyone who uses Armorite once uses it always.

The Bryant Electric company of Bridgeport, Conn., with western office at 1522 Monadnock block, Chicago, has issued a 16-page catalogue supplement. It includes all of the latest specialties which the Bryant company is manufacturing, and as many of these are new and will undoubtedly be found of interest to the trade, a copy ought to be valuable to every man in the electrical business.

Secretary J. S. Speer of the Partridge Carbon company of Sandusky, Ohio, visited Chicago last week. Mr. Speer is an indefatigable worker, and the Partridge company owes much of its success to his energetic and aggressive efforts. His stay in Chicago was a busy one, as in addition to his business acquaintances he has a host of warm friends, who do their best to tempt him into social functions.

E. W. Hammer, late secretary of the Cutler-Hammer Manufacturing company of Chicago, has sold his interest in the company to Horace S. Smith and Harry H. Cutler. Mr. Smith is well known to the mechanical world as the late general manager and vice-president of the Illinois Steel company, and Mr. Cutler needs no introduction to the electrical trade. The company has been reorganized and put upon a sound financial basis, with a largely increased capital. The factory is being enlarged to take care of the rapidly growing business, and to better enable it to keep up its reputation for prompt shipments and high-class work.

The new power company at Niagara Falls has now in successful operation its new power plant, comprising four of the Leffel Niagara type of turbines, each of about 2,200 horse power capacity or giving in all some 9,000 horse power. These turbines drive eight generators of something over 1,000 horse power each, two generators being connected directly to the shaft of each wheel, one being placed on each side. The James Leffel & Co asserts that this comprises the most complete and perfect electric water power plant in the world. The same power company has four other of the Leffel Niagara turbines, using in all eight of that style of wheel.

K. McLennan & Co. of Chicago, the sole manufacturers of Gale's commutator compound, state that the sales of their compound during 1896 have more than trebled that of any previous year, that whatever "Gale's" has been tried it becomes readily adopted, that at this time more than three-fourths of the power plants and central stations have adopted it, and that it is now universally conceded to be a "dynamo necessity." To isolated plants as well as central stations and power plants, where this compound has not been tried, the firm will continue to send upon request a free sample stick. They further assert that this compound has been equally well received in Canada and Mexico as well as in Europe, where recent large shipments have been made, and that requests for samples have been received from nearly every section of the civilized world.

In the course of an interesting review of its business for 1896, the Joseph Dixon Crucible company of Jersey City says: "Altogether our experience is that 1896 has been a season of hard times and many moments of uncertainty, but nevertheless the spirit of self-help and mutual help has been alive all the time and is now making itself felt in the way of better business, which will be still better later on. * * * * As for 1897, business prospects are good—at least good to all who are in any way hopeful or energetic. Even in 1896 we quite largely increased our business in those lines where we put in some extra hard and intelligent work. Probably business men are not exceptions to Mr. Atkinson's favorite quotation from Emerson, 'Man is as lazy as he dares to be,' and we shall therefore shake off any lethargy that may have settled on us, and start in on 1897 at a record pace, for collections are now very good, and everything so far as we can see is encouraging to all manufacturers for both home and export trade." However, the hard times of '96 did not cause the company to forego its customary Christmas pencil-box reminder to its newspaper friends. The appropriate gift is appreciated.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued December 22, 1896.

573,441. Telephone Attachment. William O. Christopher, Hillsborough, Tex. Application filed August 29, 1895.

This attachment consists of an oblong loop, insulated for a portion of its length, the main portion of which is sufficiently wide to be passed horizontally over the outer hook end of a telephone switch-lever, the loop being provided at both ends with elongated contracted necks, one of which is adapted to engage the shank of the switch-lever in rear of the hook end to allow the loop to normally assume a vertical position, and thereby detachably lock itself on the switch-lever, and a hook connection between the other contracted neck of the loop and the receiver wires, whereby a dropping of the telephone receiver will exert a pull on the switch-lever through the medium of the loop.

573,464. Electric Arc Lamp. Edward P. Hopkins, New York, N. Y. Application filed June 13, 1894.

The combination with the carbon holders of a spring clock-train, having an initial tension and mounted in a frame having a fixed position, the clock-train acting to positively feed the carbons together, a regulating electro-magnet for controlling the feeding movement located in a constantly closed shunt circuit around the arc and blocking the clock movement in the retracted position of its armature, and an electro-magnet located in series with the arc and acting to separate the carbons to form the arc independently of the feeding mechanism, whereby varying quantities of current may be passed through the lamp without affecting the regulation thereof.

573,485. Process of and Machine for Magnetic Separation. Richard H. Sanders and Charles T. Thompson, Philadelphia, Pa. Application filed August 10, 1892.

The process consists in feeding stock into a diffusely shunted field between a magnet and a moving armature of substantially continuous mass, conducting the ore through the field suspended in strias supported at the end farthest from the magnet, and thereby delaying the passage of the ore through the field, permitting the gangue to escape during the period of delayed conveyance, removing the ore from the field still supported as aforesaid, and finally discharging it.

573,493. Electric Battery. Albert E. Stephenson, Chicago, Ill. Application filed June 29, 1896.

The inventor specifies a method of constructing and connecting batteries.

573,496. Apparatus for Preventing Collisions on Electric Railways. Benjamin C. Tilghman, Jr., Philadelphia, Pa. Application filed April 13, 1894.

The second claim reads: The combination with two electrically operated roads which meet or cross each other, of a source of electrical supply, an insulated sectional conductor connected to said source of electrical supply and adapted to furnish power to a vehicle traveling on a portion of one road, and means operated by one vehicle traveling on a predetermined portion of the other road for cutting off the current from the insulated conductor of the first road.

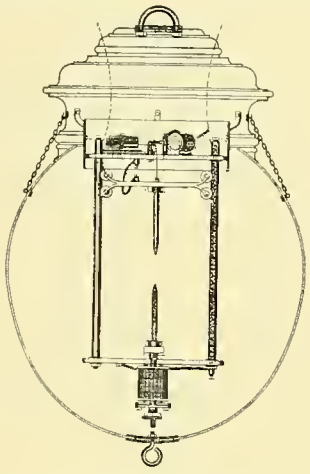
573,517. Trolley Pole Governor. Vernon T. Lynch, Chicago, Ill. Application filed March 4, 1896.

The combination with an upwardly pressed trolley pole, of a drum about which a rope attached to the trolley pole is adapted to be wound, a spring for rotating the drum to maintain the rope taut, a second drum whereon the rope is also adapted to be wound, a spring for rotating the same, a catch normally maintaining the second drum against rotation, a locking device for locking the drums together, and means controlled by the rapid rotation of the first-mentioned drum for actuating the locking device to lock the drums together and for releasing the catch to permit the drums to rotate to wind up the rope upon the second-mentioned drum and draw the trolley pole downward.

573,526. Electric Arc Lamp. Eugen Hugo Arthur Heinrich Ritter von Nollendorf, Vienna, Austria-Hungary. Application filed April 9, 1896.

A drum is pivoted on the frame to turn in a horizontal plane; a cord is connected to the upper carbon holder and drum; an escapement wheel is adapted to turn independently of the drum in one direction. In combination with these are means for locking the drum and escapement wheel together, a pallet pivotally mounted on the frame to swing in a horizontal plane, in operative connection with the escapement wheel, a magnet for operating the pallet and conductors electrically connected with the carbons and magnet.

573,535. Trolley Adjusting and Regulating Device. Charles F. Randall, Denver, Colo. Application filed March 31, 1896.



NO. 573,526.

Features of this device are a casing comprising two compartments, two weights, one located in each compartment, a yielding pin attached to the weight in one compartment and having a limited vertical movement, a pawl pivoted on the pin and a spring-held dog suitably supported and having one extremity normally projecting into the path of the ratchet-bar, and the other extremity engaging and supporting the weight in the second compartment, the trolley rope being connected with the weights in the two compartments.

573,558. Electrical Resistance Device. Detlef C. Voss, Malden, Mass. Application filed March 16, 1896.

This device is described in the first claim as an article of manufacture having a solidified electric conductor composed of carbonized fibrous material, a metallic oxide and a binder.

573,575. Telephone Exchange System. William W. Dean, St. Louis, Mo. Application filed June 11, 1896.

The combination with metallic circuit and grounded telephone lines, of a common battery, and an additional battery in circuit with the grounded lines and adapted to supply additional electromotive force to the grounded lines, whereby the standard current may be maintained upon both metallic circuit and grounded lines.

573,576. Common Battery Telephone System. William W. Dean, St. Louis, Mo. Application filed September 19, 1896.

There is claimed the combination of a local transmitter circuit, comprising primary and secondary helices of an induction coil and a microphone included in circuit with a telephone line, and a centralized battery adapted to direct current in series over the line through the primary and secondary helices and microphone, the primary and secondary helices being also connected in series in the path of the voice currents.

573,581. Electric Engine. Isaac T. Dyer, Chicago, Ill. Application filed March 30, 1896.

The first claim is given: An electric motor, comprising in combination with an electric generator a pair of solenoid magnets and their cores coupled endwise together, a lever connected with said cores to be oscillated by their reciprocating movement and adapted to be connected with the driver of an engine, and a switch device having a pair of stationary contacts in the generator circuit and a pair of spring-controlled movable contacts adjacent to said stationary contacts and respectively connected electrically with said magnets, a pendulously supported lever extending between said movable contacts, and shifting lever mechanism engaging said pendulous lever.

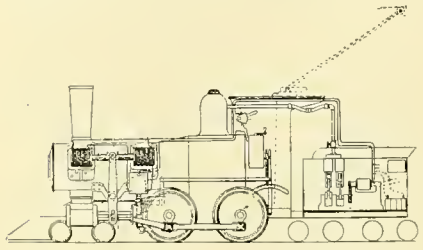
573,591. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. Application filed March 12, 1885.

In this signaling apparatus there is a transmitter and a signal changer, together with a signal designator, consisting of an indicating surface or "field," bearing indications grouped in two substantially intersecting directions cooperating with an indicator, one of these movable with respect to the other in such manner as to designate any desired indication; also means whereby the signal transmitted is varied to correspond with the indication.

573,592. Electric Signaling Apparatus. Felix B. Herzog and Schuyler S. Wheeler, New York, N. Y. Application filed January 29, 1886.

At a sending station a transmitter organized to transmit two separate variable signals at one transmission, and at a receiving station an apparatus comprising two step-by-step wheels, each controlled by a magnet, the first magnet being controlled by the first part of the transmission, and the second by the second part.

573,601. Electrical Switching Apparatus. Francis W. Jones, New York, N. Y. Application filed October 15, 1896.



NO. 573,581.

The combination in a switching apparatus of a spring-jack, a flexible conducting cord, a take-up device therefor, a plug forming the terminal of the cord having contact-points co-operating with the contact-points in the jack, and means for locking or holding the cord at a point between the plug and the take-up device, whereby the cord when in use may be relieved from the influence of the take-up.

573,612. Electrical Connecting Cord. Charles H. McEvoy, Lowell, Mass. Application filed February 24, 1896.

A flexible electric conductor, comprising a conducting core, a conducting tip in electrical connection with the core, a non-conducting supporting cord and a link arranged to surround the tip and to receive the supporting cord.

573,617. Electric Arc Lamp. Paul Franz Herrmann Queisser, Charlottenburg, Germany. Application filed January 24, 1896.

There is an electro-magnet, having a laminated core, the two ends of which are cut away obliquely in one plane, in combination with a pivoted armature lever, the movement of which controls the feeding of the carbons, and a laminated armature carried upon the lever and adapted to vibrate between the parallel poles of the core, the axis of the armature being substantially parallel to the oblique face of the ends or poles of the core, the face of the armature opposed to the parallel edges of the poles being tapered to thereby gradually decrease the air-gaps as the armature is attracted.

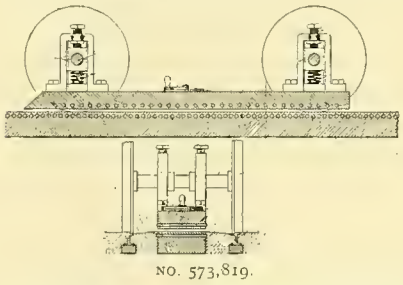
573,629. Electric Heater. Harry L. Tyler, Corning, N. Y. Application filed August 6, 1896.

In the third claim is specified an electric heater, comprising an electric conductor, an insulating inclosure therefor containing glycerine, and an outer receptacle containing a body of heat-conducting material and having heat radiating walls.

573,645. Automatic System of Distribution and Control for Electric Railways, etc. William H. Cooley, Brockport, N. Y. Application filed August 3, 1895.

Claim one is given: In an electric railway system, a continuous feeder, a series of working conductors normally unsupplied with current from such continuous feeder sufficient to operate the motor cars on such system, means under the control of devices on the motor cars of such system for connecting directly to such continuous feeder the working conductors contained on any block in such system on which a first one of such motor cars happens at any time to be, means for preventing a second motor car subsequently arriving on an adjacent block, whether to the rear or in front of such first-named block, from similarly connecting to such continuous feeder the working conductors contained on such adjacent block or section in such system.

573,647. System for Generating and Distributing Electrical Energy. Charles M. Green, Cleveland, Ohio. Application filed May 23, 1896.



NO. 573,819.

The combination with a dynamo provided with two or more separate sets or groups of armature coils or bobbins, and a commutator for each set or group, of two or more working circuits, each having translating devices included therein, the working circuits each being connected between and included in series with the separate groups of armature coils or bobbins, and automatic cut-outs arranged and adapted to provide a shunt circuit of low resistance around each one of the working circuits.

573,716. Electric Signal Operating Device for Railway Trains. George F. Singer and Frank K. Singer, Mingo Junction, Ohio. Application filed May 22, 1896.

A train signal, comprising a battery and an alarm at each end of the train, circuit wires on which the batteries and signals are located, and a coupling for the circuits comprising two casings, a block of insulating material in each casing, resilient contact-fingers secured to opposite sides of the blocks, the free end of each contact-finger being curved inward and then outward, and a thin plate of insulating material extended from the block of each section between and nearly to the end of the contact-fingers, whereby when the two coupling sections are placed together the plate of one section will rest upon the plate of the other section.

573,723. Electric Floor Push. Henry C. Thomson, Boston, Mass. Application filed March 28, 1896.

The combination of a perforated cap, a connected, headed, hollow shank having its extremities insulated from each other, a pin physically but not electrically connecting the upper and lower portions of the shank, a sustaining plate, and a plug attached thereto, and proper circuit connections therefor.

573,741. Electric Metal Separator. Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, Ohio. Application filed November 8, 1895.

A magnet has the faces of its oppositely placed poles recessed to form a passage or conduit, and a mass of diamagnetic metal is embraced between the opposite faces of the poles and extending longitudinally of the passage, and adapted to divide the current and deflect the material toward the poles.

573,750. Combined Lightning and Water Conductor. Lawson Adams, Buffalo, N. Y. Application filed September 30, 1896.

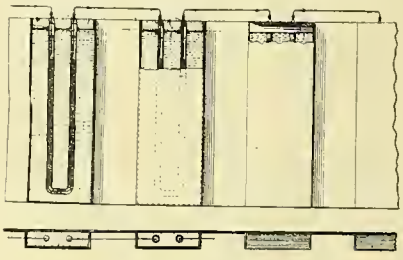
Two sections of connected adjacent pipes, both open on one side and forming a combined lightning and water conductor, are united. The joint consists of twin apertured plates, having registering surfaces and provided with side-apertured lugs for securing the plates together at the registering surfaces, the sides of the plates opposite the registering surfaces being provided with hollow tapering extensions adapted for union with the ends of the combined lightning and water conductor sections.

573,767. Automatic Speed Regulator for Electromotors. Louis Denayrouze, Paris, France. Application filed November 26, 1895.

This is a governor for electric motors, comprising a contact disk mounted on the motor shaft and connected with one brush of the commutator, a disk mounted on and insulated from the motor shaft, and provided with a contact, electric connection of the disk with the generator, and a contact having a flexible connection with the shaft, and adapted to engage the former contact.

573,807. Electric Switch. Walter Boardman and Harris Boardman, Lancaster, Pa. Application filed March 28, 1896.

The combination of a base having an opening, arms projected from the inner side of the base and in a direction parallel with the longitudinal extent of the base-opening, a push-pin extended through the base-opening, a transverse bar between its ends secured to the inner end of the pin and at one end extended between and guided by the arms, a switch-throwing device carried by the opposite end of the arm, and a switch.



NO. 573,629.

573,809. Elevator Mechanism. John H. Clark, Boston, Mass. Application filed July 28, 1890.

This is a patent for an electrically operated elevator, in which two worm-gears and an electric brake are used.

573,817. Electric Light Support. Elisha J. Fulghum, Traverse City, Mich. Application filed June 24, 1895.

The cord supporting the lamp is wound upon a spring-drum and thus controlled.

573,819. Electric Railway. Paul W. Leffler, Chicago, Ill. Application filed August 12, 1895.

This is an electro-magnetic railway, in which a number of field magnets extending along the line of travel operate on an armature or series of co-operating magnetic sections arranged longitudinally of the car. A controller on the car renders the magnetic sections operative or inoperative, cumulatively in pairs, one on each side of the center of the armature.

573,820. Electric Elevator. Paul W. Leffler, Chicago, Ill. Application filed August 19, 1895.

This is similar in principle to the preceding patent. The car is provided with an armature, while the magnetic field-producing devices and guide extend along the line of travel for co-operation with the armature and car to propel and guide the latter.

573,821. Electric Railway, etc. Paul W. Leffler, Chicago, Ill. Application filed September 26, 1895.

The combination with a car or other traveling body, of field magnets extending along the line of travel, and a rotary magnetic body carried by the car body, having one or more spirally arranged pole-pieces subject to the action of the field.

573,822. Electric Railway, etc. Paul W. Leffler, Chicago, Ill. Application filed March 11, 1896.

The combination with a car or other traveling body, having an armature, of field magnets in the line of travel, and supply-circuit connections for the field arranged to divide the same into successive sections, adapted to be connected up in series into the supply circuit, and including as parts thereof a series of automatic switches which normally cut the field section magnets entirely out of the supply circuit, but are operative by the car to close into the supply circuit the particular section or sections of the field over which the car is passing.

573,823. Motor Car Truck. Paul W. Leffler, Chicago, Ill. Application filed March 21, 1896.

The combination with a sectional truck, of a sectional armature, carried one section on each of the truck sections, and a common universal joint or joints applied to couple together the truck sections and the armature sections.

573,830. Electric Arc Lamp. John A. Mosher, Chicago, Ill. Application filed October 22, 1896.

In an electric arc lamp having its electrodes drawn together by gravity, the combination with the carbon carrier, of a ratchet wheel co-operating therewith, a lever, a pawl for co-operating with the ratchet wheel to separate the electrodes and being movably attached to the lever, a spring for holding the pawl in its advanced position upon the lever, an electro-magnet having its coil in series with the lamp, connection between the lever and the magnet, whereby the latter tends to engage the pawl with the ratchet wheel, and a retractile spring for opposing the action of the magnet.

Western Electrician.

EVERY SATURDAY.

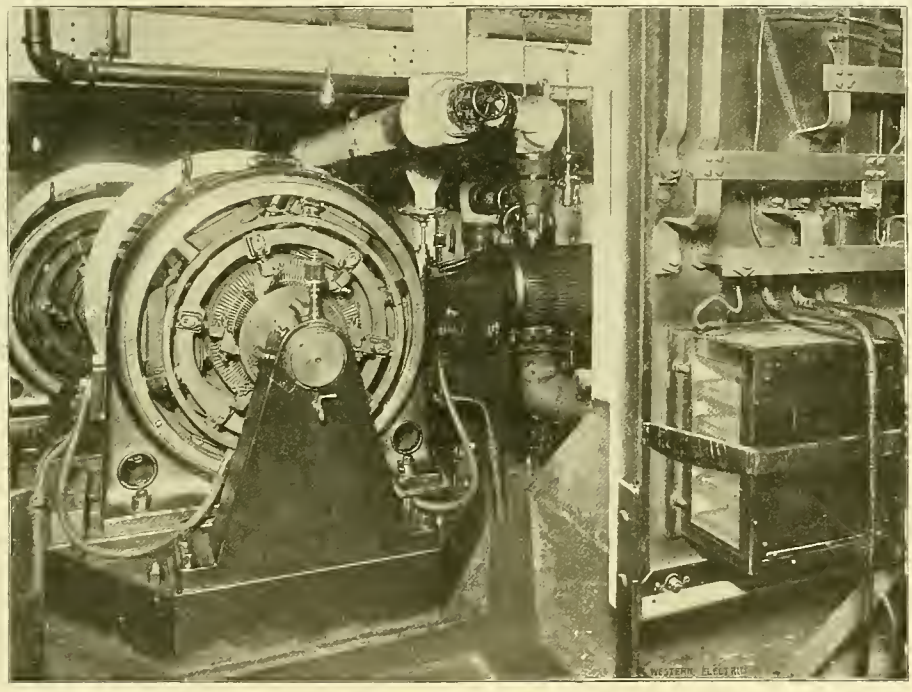
Vol. XX. CHICAGO, JANUARY 9, 1897. No. 2

A Cramped Isolated Plant.

A curiously arranged plant is that in the basement of the Association building, Chicago, which furnishes the heat, light and power for that building and steam for two adjacent restaurants. Much of the apparatus is excellent, but the general arrangement is so inconvenient and awkward that it might serve as an object lesson of how not to do it. The elevators are of the horizontal, hydraulic type, and the machinery takes up an inordinate amount of space and is so placed that, although the basement is large, everything else is crowded and subordinate to it. The boilers are away off in a distant corner, so that an unnecessarily long extent of steam piping is used to reach the dynamo engines, and they face in two directions, compelling the firemen to pass around the projecting corner of one front to get at the other set. The switchboard juts into the passageway leading to the dynamos, instead of being back against the wall, and so the back of it is rather more accessible than the front, as may be judged by the accompanying illustration. The pumps are also badly arranged, and altogether the plant is susceptible of great improvement.

There are four boilers—two of the Heine water-tube type of 250 horse power each, and two Mohr tubular boilers rated at 75 horse power each. The two engine-dynamos are duplicates in all respects save size, and consist of Ames simple engines of 150 and 75 horse power respectively, made by the Ames Iron Works of Oswego, N. Y., directly coupled to Westinghouse six-pole direct current 110 volt dynamos of 75 and 37½ kilowatts. The larger unit is operated at 290 revolutions per minute, and the other at 220 revolutions.

From the switchboard, which is of white marble with Weston ammeters and voltmeter, about 1,800 incandescent lamps are fed. There are also two motors in the building. One on the 13th floor drives a ventilating fan, while the other is used in winter to force hot air into the gymnasium. A few arc lamps are also wired on the incandescent circuits. The main risers of the wiring system are carried in the air shafts, and there are two cut-out boxes on each floor.



A CRAMPED ISOLATED PLANT.

Electrical Contract for the St. Anthony Falls Plant.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The St. Anthony Falls Power company of Minneapolis has awarded the contract for furnishing and installing the apparatus for the new electrical plant which will transmit power from the new dam across the Mississippi river. The General Electric company of New York is the successful bidder, the price approximating $300,000. This plant is to be second only to the Niagara Falls plant in the amount of water power devoted to the development of electricity and equaling that in being strictly modern in all details. There will be 7,000 horse power developed by the plant, to be used by the Twin City Rapid Transit company in propelling its electric cars in Mineapolis and St. Paul, the former taking 4,000 horse power and the latter 3,000. It is expected to have the new plant furnishing this power by July 1, 1897. When the plant is completed the street railway company will dismantle most of its existing power stations, two being kept in reserve in case of accident and to furnish extra power for an emergency. To William de la Barre, of the water power company, is due the credit for the success of this work. Chas. G. Armstrong of Chicago is associated with him as consulting engineer, and Forée Bain of Chicago is consulting electrical engineer for the Twin City company.

City Hall Methods Exposed.

Considerable attention has been attracted to the matter of furnishing fire-alarm boxes to the city by the determined attitude of James W. Johnson, a well-known Chicago electrical man and the agent of the United States Fire & Police Telegraph company of Boston. Mr. Johnson shows conclusively that rank favoritism has been shown to the Gamewell company in the purchase of boxes, to the detriment of the taxpayers' pockets, and the news is no surprise to those who are familiar with John P. Barrett's methods in running the city electrical department. Mr. Johnson shows that the city would have lost between $3,000 and $4,000 by the action of Mr. Swenie, the fire marshal, and his adviser, Prof. Barrett, and offered to forfeit a certified check for $500 if his statement, on being subjected to the proof, was not found to be correct.

Bids for furnishing 75 fire-alarm and 25 police alarm boxes to the city were advertised for by the fire marshal on December 19th. The boxes, it was stated, must be in every way similar to the sample in the office of the city telegraph department, which was a Gamewell box. Of course this excluded all competition, and enabled the Gamewell company, under the specifications of Swenie and Barrett, to fix its own price. The date set for going through the farce of opening bids was December 30th and the figure set by the Gamewell people was $100 per box—the old price. On that day Mr. Johnson filed the following written protest with Mr. Swenie:

Referring to advertisement dated December 19, 1896, for fire and police signal boxes, we respectfully protest that the specifications are so drafted as to prevent competition and to favor a rival manufacturer.

We stand ready to give you the benefit of competition if you want it, and as an indication of our faith in our ability to furnish you something just as efficient and reliable, we guarantee that if you will submit specifications that admit of competition we will be the means of saving the city of Chicago at least $40 per box for fire-alarm boxes on the basis of the prices heretofore paid by the city.

To comply literally with the specifications as drafted would require us to put the name of a rival manufacturer on our product. We are not prepared to do this, but we are prepared to furnish Chicago with boxes equal in all particulars to the samples exhibited, and if you will permit us to send a sample to our factory we will construct and submit for your approval a box such as we would furnish.

To supplement this, Mr. Johnson wrote a letter to Mayor Swift in which he said:

The bid of the Police Telephone & Signal company, which was the only one received, is $100 each for fire-alarm boxes, just double the price at which similar boxes are purchased by other cities having the advantage of competition.

Under the terms of the advertisement the fire marshal has a right to reject the bid received from the Police Telephone & Signal company and readvertise, and we respectfully urge you to take such action as will bring about this result, which will without question save the city of Chicago between $3,000 and $4,000. Under proper and impartial specification, San Francisco, Boston, Cleveland, Columbus, Ohio, and over 30 other cities are using our boxes, as well as boxes of the Gamewell type, and the insurance underwriters put them on the same basis and indorse their use in conjunction in the same systems. We are willing to back up our guarantee made in the communication to the fire marshal by depositing with you a certified check for $500, to be forfeited to the city in the event of your failure to receive bona fide bids on fire-alarm boxes equal in every particular to the sample exhibited of at least $40 per box less than the price named in the bid received to-day. On 75 boxes this means $3,000 saving to the city.

Mr. Johnson had an interview with the mayor, armed with his $500 check, but His Honor at that time refused to interfere and referred the matter back to Chief Swenie, who, acting, undoubtedly, on Prof. Barrett's advice, stated, on the 31st, that the contract would go to the Gamewell company, the prices to be $100 for the fire-alarm boxes and $75 for the police boxes. Prof. Barrett explained his position by stating that the Gamewell box had been in use in Chicago for 31 years, and that for 17 years not a single failure to register an alarm had resulted. Last year in New York, he said, where they use several styles of boxes, there were 131 failures to register alarms. Prof. Barrett claimed that he was not willing to take any chances by using an inferior grade of alarm box.

To this Mr. Johnson replies that the Chester type of box supplied by the Gamewell company is used exclusively in New York, while there are several different types in Chicago. It is not true, he says, to say that the Chicago boxes never fail to register an alarm, and he cites a case at the Tolman fire in Lake street last April, when an adjacent box was pulled by a fire chief of battalion, but there was no alarm. Mr. Johnson is also prepared to state that the Gamewell box of the type used in Chicago has been sold in Cleveland, O., and Sacramento, Cal., for $50.

On January 5th it was announced that Chief Swenie, on the advice of the mayor, would readvertise for bids, on terms allowing all to compete. This is a knock-out blow for Barrett.

Decorative Lighting.[1]

By E. J. Jenness.

In taking up the subject of decorative lighting, I will first consider lighting effects as applied to scenic theaters. The first thing is to know the scene to be lighted and what effects are to be produced. For an illustration I will use a scene that was probably familiar to some of you during the summer of 1893—the scenic theater of the Western Electric company, Electricity Building, World's Fair. The scene, as shown in Fig. 1, consisted of an imaginary Swiss landscape, with small village in the foreground, gradually rising ground, foothills and a mountain for background. The effect desired was to imitate the shades of light produced by nature in 24 hours, in the following order: Early dawn, sunrise, morning, noonday, gathering storm, storm, clearing off, afternoon, sunset, twilight and stars, moonlight. To produce these effects, it is necessary that the operator be familiar with all the combination of lights under his control. This knowledge can only be acquired by actual, practical experience in operating a scenic theater.

To properly light this scene, with a proscenium opening of about 8 by 10 feet, requires the equivalent of 300

FIG. 1. DECORATIVE LIGHTING—WORLD'S FAIR SCENIC THEATER.

sixteen candle power lamps and about 125 amperes of current at 110 volts, for the most brilliant illumination. Any standard theater dimmer can be used that can be controlled mechanically and does not cut out the resistance too rapidly and by too great steps. The rheostats which we use are the Barriston & Fanning type, consisting of sheet-iron drum, insulated with asbestos and wound with German silver wire of different gauges, beginning with large wire at one end and gradually reducing the size. These rheostats are mounted on a frame carrying a shaft, with tight and loose pulleys for operating the contact slide up or down automatically. The location of rheostats must be where the operator can have full view of the scene, otherwise the effects produced can never be satisfactory, as at times in the scene the very closest attention is necessary. The rheostats should have capacity to dim out the circuits to which they are connected, as absolute darkness is necessary at times.

The arrangement of lights in the scene is as follows (all lamps mounted in tin-lined gutters): Overhead, three rows each of 20 lights, one row of ground glass, one row of red, one row of blue lights; right-hand proscenum, two rows 10 lights each, one of red, one row of blue lights; foothills, two rows of 10 lights each, one of red, one of blue; mountain, two rows of 15 lights each, one red, one blue. The left-hand lights are the same as the right-hand. All blue lamps are of 32 candle power. The sun has fifteen 32 candle power lamps (80 volt) on 110 volt circuit; the moon, three 16 candle power green lamps, while the starlight is from 35 sixteen candle power lamps behind sky curtain, with small holes pierced through.

The different effects are produced by the following combination of lights: Early dawn, ground glass at very low candle power; just before sunrise, ground glass, east reds and sun behind red-brown glass, sun on one-half candle power; sunrise, ground glass reds, sun at full candle power but still behind glass; morning, ground glass reds, sun moving from behind glass; noonday, sun and blues, the blues clearing out the haze which is common in the morning light; storm, sun very low, ground glass, a little red. Lightning is made with a stereopticon outfit with camera shutter; the slide has different kinds of lightning scratched on the surface. Sunset color is about the same as sunrise, with little more red and some blue, for the purple effects. Great care is necessary at this point to dim the sun, blues and reds at the right time, or you lose all the brilliant purple effects, and get a sickly blue that is far from desirable.

In setting up and adjusting the rheostat to stop at the right point, the operator should use plenty of time and bring these effects on slowly, so as to become familiar with the exact effect produced by any circuit coming in at any time. For example, at noonday, with the sun at full power, the reds can be added and the red will hardly be noticed; if this is done in the morning the result would be somewhat startling.

In operating the apparatus to produce the 24-hour cycle, the beginning, of course, is darkness. For early dawn the rheostat controlling ground glass circuit is started; as this light begins to show, the red borders begin; as soon as you can see the reds, the sun rheostat is started. As soon as the sun is at full candle power it is moved from behind the glass screen and the blues added; when blues are up it is noon. The reds have been dimmed out while blues were coming in. Now dim the blues, then the sun, add a little red, and we have the right sky for storm. Next we have the lightning, then clearing sky, by bringing up sun and blues. Now for sunset; dim sun slightly, reds coming up, blues going down. If the sun and blues are dimmed exactly right, and the reds brought up at the right time, your scene will change from bright sunlight to afternoon haze, to the beautiful reddish purple and afterward to the red glow, so common in many places away from Chicago. As it becomes dark enough, the stars are visible. Then the moonlight; add a little blue, and you have an evening that is all that can be desired. Drop your curtain, throw over the switch on the house lights and you are through another day.

There are a number of different methods of controlling the rheostats, in these theaters. One system has clutches operated by magnets controlled by push buttons; this adds a large amount of apparatus to get out of order and also heavy first cost. Still another method has cams arranged on a shaft to throw in and out all switches, operate the rheostat and all other parts. This is even more complicated and expensive. The results obtained are the same; however, this is an excellent scheme if you have a poor operator, as he cannot bring on a green sunrise and a blue sunset and then add a red moon. Yet, if you have a good operator, the changes which are made in the scene, from time to time, make it all the more natural. One of the worst things that can happen to you in operating a theater is to have a fuse blow in all the reds at sunset; the result is a brilliant blue and never fails to bring an encore.

Secondly, I will speak of decorative work as applied to tower lighting for advertising or other purposes. The treatment of any tower depends, of course, on size and location, whether it is to be seen from far or near, in or out of doors. As I had a little experience with one a few years ago, I will use that to illustrate. This tower was 250 feet tall, 48 feet square at the base. The architect's drawings showed the tower covered with a miscellaneous assortment of designs, using about 8,000 lights. As we were limited to 3,000, it was necessary to make a complete change, as 5,000 could not be taken off the tower in a lump without being noticed. It was decided at the outset to use part stationary and part "movable" lights; by "movable" I mean lights to be lighted and put out by automatic switch.

By referring to Fig. 2 you will have an idea of the tower as it was in actual operation. The arrangement of the lights was as shown: Rows of 16 candle power whites up the four corners of the tower two feet apart, cross-bars in white, dividing the tower into nine parts above the first platform, two rows in white around each platform with a third row of 32 candle power reds at the extreme top. The center division between each plat-

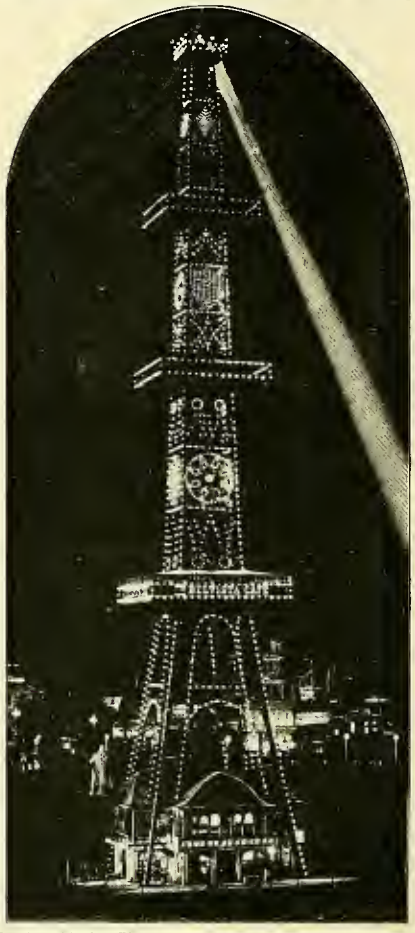


FIG. 2. DECORATIVE LIGHTING—ELECTRIC TOWER AT SAN FRANCISCO.

form was used for movable design in white with a few stationary reds. The upper and lower division had designs of curves in red. The only color that can be used for this class of outside work is red. Blues are not visible, except when used in large numbers and close together; greens are sickly, and nearly all colors are open to objection.

Discretion should be used in placing all the outline and other stationary lights to utilize the effect to the fullest extent. Place them as far apart as you possibly can, and still retain the effect. By placing the lights close together, the large number required brings the cost too high. In works on as large a scale as this tower, outlines and other stationary lights can be placed from 18 to 24 inches apart, and give an effect that is all that can be desired. In movable effects the designer can use all the ingenuity he possesses, and then he will not know, until he sees the operation, whether his work is going to be effective or not. In any movable design, the idea is to deceive the eye into seeing a moving figure, where there is actually one stationary—not a very easy thing to do. To accomplish it, it becomes necessary to light the circuits faster than the eye can follow, or from six to 10 per second. This speed depends somewhat on the length of circuits and number of lights. A safe rule is to light as many as six circuits per second. This may seem somewhat rapid to anyone who has seen some of the moving designs around the city.

The switch that is used to operate these movable designs consists of a number of disks mounted on a shaft carrying cams on the periphery of each disk. The arrangement of these cams is shown by Fig. 3, which represents the periphery of the cylinder unrolled and shown flat; the number of circuits shown is 21. The cylinder is to rotate twice per minute, so division of diagram horizontally represents seconds. The circuits are indicated by the numbers running from one to 21. In making this diagram it is necessary to have a clear idea of what you want the design to do. We will get a clearer idea of the method used by referring to Fig. 4. This design seems very simple, but was one of the most effective used on the tower. The idea is to imitate a hand writing letter e's around a circle. The numbers on the design note the beginnings of the circuits. These circuits all lead to the switch and are connected as shown in Fig. 5.

Fig. 3 represents the length of contact cams in seconds. You will note in the beginning that the 21 circuits light in three seconds, that the length of cam on the 21st circuit is two-sevenths of a second, and that circuit No. 1 has a cam one second long. The effect on

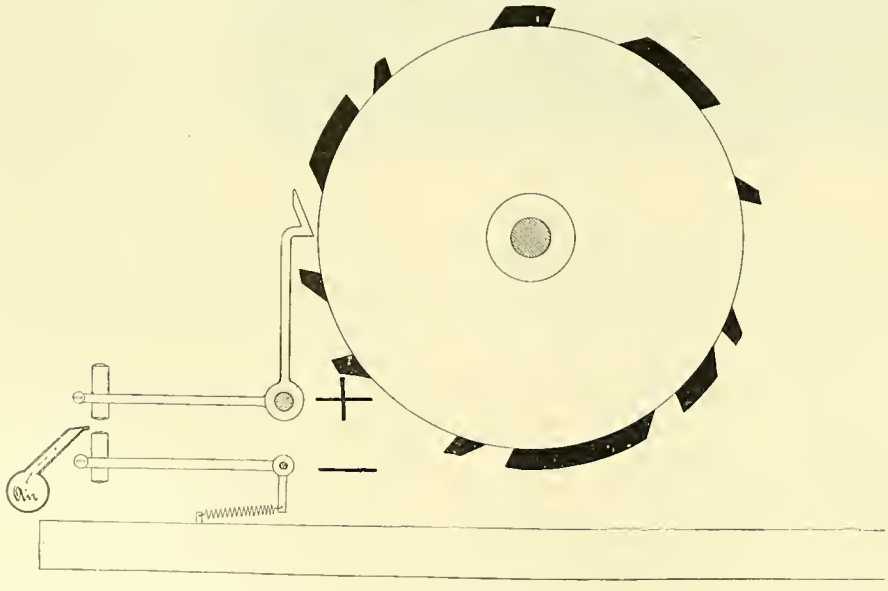


FIG. 5. DECORATIVE LIGHTING.

1. Read before the Chicago Electrical association, December 6, 1896.

he design is to have the amount of light constantly increase until the entire design is lighted, as indicated on the diagram when the cams are three seconds long. After coming to the point where the entire design is alight, the entire 21 circuits go out in one second. This is very rapid, in fact almost a flash around the circle. After this the design is dark one second; then lighted from both ways in three seconds; after this darkness for one second; then all 21 circuits light at once, then all go out at once; darkness one second; then begin to light again from both ways. All lighted in one second, stay lighted one second; then go out in one second; dark one second; then all light in three seconds; then in two seconds, then in one second. Now the cams are very short, about two-sevenths of second; dark one second, then all light at once and stay lighted two seconds. Then the design repeats or can be stopped on these cams and remain lighted.

This method of laying out the work of different designs and circuits is very satisfactory, as the exact arrangement can be made, and all cams cut to the required length without using the old cut-and-try method. In any scheme of decoration, the idea should be to gradually reach a climax, at which time all the lights should be lighted; unless this can be done the best results are not obtained. In many instances there is not capacity enough in the plant to light all the lamps at one time; if such is the case it is much better to reduce the number until they can all be lighted. The failure of the tower on the corner of State and Van Buren streets can probably be laid to this reason. There are other reasons as well. Some of them might be mentioned as lack of design, poor scheme of operating, more than enough lamps. If this tower had been designed with simple outlines in white lights, with geometrical designs around the center of five divisions, then simple outlines in red, with scroll designs around the five centers, five designs in the centers on automatic switch, reds and whites on separate circuits to be used alone or both together, the result would have been excellent, and the cost about one-half the present installation. The two revolving stars a little farther down State street are excellent. By putting the colored and white lights on different circuits, and varying the speed of rotation, this design can be made most effective. Unless changes are made in this class of work, the design becomes monotonous and does not attract the attention desired.

On these movable designs, I find it good policy to have the cylinder of the automatic switch controlled so as to vary the speed from one to six revolutions per minute. This gives almost endless variety, as the effects change very rapidly as the speed increases. Fig. 5 shows one disk with cams of circuit No. 21 in position, with arrangement for breaking the circuit. The cams push out the upper lever, making contact through the carbons. On breaking the circuit the arc would be held across, unless a blow-out were used. The arrangement of the air tubes is shown on the left. A tube with flattened end is placed just where the arc comes. These contacts make excellent arc lamps, if you forget to start your blower.

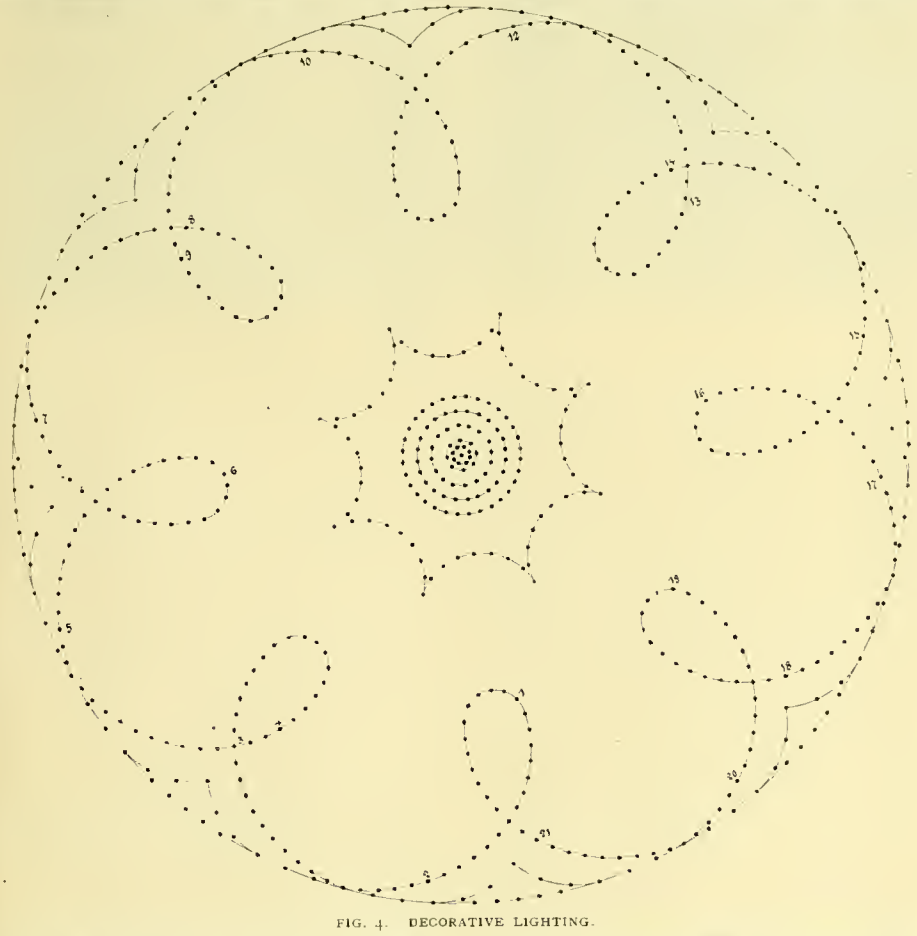


FIG. 4. DECORATIVE LIGHTING.

I wish to enter a protest against the scheme of lighting in use in so many halls and public buildings in Chicago and elsewhere, viz., that of arranging the lights in rows directly in front of the visitor's eyes, where he is obliged to sit and be blinded by the fearful glare. The Auditorium is a shining example of this scheme. This scheme may be a "thing of beauty," but it is not a "joy forever" to the people who go there. No scheme of lighting can be called a success when it causes the amount of suffering that those rows of light do at the Auditorium. As a sharp contrast to this, I wish to cite the entrance of the Manhattan Insurance Building in New York. As you enter you are aware that the entrance is well lighted, but you hardly know how. Upon looking up, you apparently see some large openings in the ceiling, covered with ground glass, behind which are the lights. Upon looking more closely, you see that there are hemispherical openings in the ceiling with the lights arranged so that you get only reflected light. The result is a beautiful, clear, soft light that is a pleasure to the eye and an artistic success.

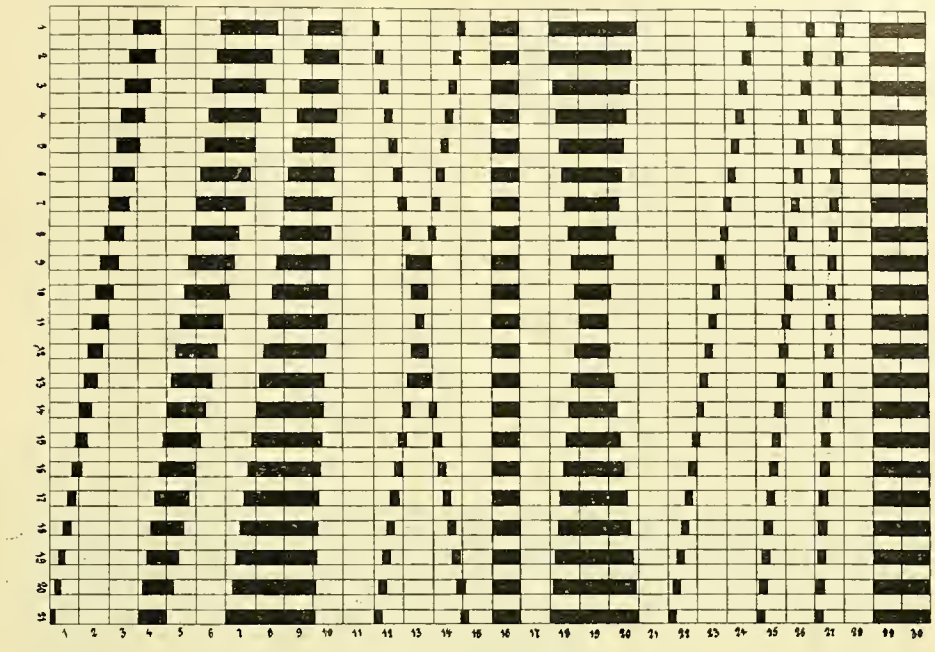


FIG. 3. DECORATIVE LIGHTING.

The Persian Gulf Cable of 1864.

By F. C. Webb.

Part I.

The landing place for the Bushire-Fao section was not at Fao, but on the sea coast outside the Shat-el-Aral and about four miles across flat land to Fao itself, which is situated close to the river. This four miles was constructed of trenched cable laid by Sir Frederick Goldsmid, who kindly undertook to superintend the native laborers.

To join the Assaye's cable to the shore we put nine miles on board the Amberwitch, which was then anchored by Lieut. Stiffe as near the landing place as she could approach, this being apparently four miles. Five miles of cable were therefore coiled into two paddle-box boats and two barges and other boats. The next day the string of seven boats started paying out toward shore; but when the two barges and one paddle-box boat had been emptied, the whole of the rest grounded on the mud, about three-quarters of a mile from the shore—if a waste of a little dryer mud could be called shore. However, there was nothing else for it than to try and drag the bight ashore, that is to say, to keep hauling out of the boat two legs of cable. The first man out sank nearly to his waist. I followed, and then followed the rest. We could not stand, we could only sit or crawl on all fours. The men sat down and hauled at the bight, and I crawled and superintended as to when they had to crawl back and get hold of some more, and so on until the end was landed. A thunderstorm came on, and we had to walk four miles barefooted over hard mud and stubble to the village of Fao. J. C. Laws and self were the last and utterly alone; nearly dark; we had no coats, waistcoats, or trousers on, nothing but shirt and drawers, no socks even. We had left all our garments in the boats. It was nearly dark, and the lightning was flashing about over our heads; and I recollect Laws, electrician like, saying, "Look here, Webb, we are the highest points on the plain," which was quite true.

The Coromandel (headquarter ship), with Lieut-Col. Stewart, etc., was anchored in the Shat-el-Aral, and sent boats to take us all on board. The next day we got off and payed out from the Amberwitch to the Assaye, and on April 7, 1864, made the final splice of the Bushire and Fao section. On April 8th we spoke through from Fao to Bushire.

Col. Stewart and Sir Charles Bright now went up to Bagdad, and placed me in charge of laying the Gwadur-Moiree section. We got to Gwadur (east bay) on April 28th, and on May 3d, at 5 P. M., began paying out from the Assaye, in tow of the Zenobia towards Moiree (a point about 17 miles from Kurrachee). We knew that we had only enough cable to go a certain distance toward Moiree, and that then we should have to cut and buoy and make for a rough harbor called Ormarra on the Meckran coast, and wait until the arrival of the Cospatrick with the last balance of cable. We payed out accordingly as usual from the Assaye in tow of the Zenobia, until we eventually buoyed with double buoys; that is, one buoy a quarter of a mile from the end and the other on the end. This is an old precaution of mine. I could write volumes on it; but at any rate in this case it proved, as it has done many and many a time before, a proper precaution.

In paying this length of cable—viz., 159.81 miles—we had one incident worth notice. I was going to say worth recording; but it is already "recorded" and printed in my report to Lieut-Col. Stewart—from which I will quote from page 29: "A little after daylight we sighted Astola, and the Amberwitch took up position No. 2, which we passed about 8 A. M. We passed the Amberwitch in position No. 3 about noon; No. 4, posi-

tion about 4; and sighted her about to take up position No. 5 at 6:30, but we kept considerably inside her."

This quotation may appear like Greek or Hebrew to many who have laid more and longer cables than I have; but the reason is this—I am a civil engineer, and do not do things haphazard. When we laid the Hague cables in 1853, we put down buoys every 10 miles to prevent the ship being swept out of her course by the tide, etc.

In the case in point the sea between Gwadur and Moiree deepens very rapidly along a line running nearly parallel to Meckran coast. The problem was to lay a comparatively heavy cable along the top of a submarine cliff. It was, therefore, arranged that Lieut. Stiffe, in the Amberwitch, should go ahead and sound out at certain positions to a certain depth, and then anchor or make signals so as to keep us off the edge of the cliff. At first, it was intended to have buoys laid; but this was eventually abandoned for the system pursued, which was most carefully and energetically carried out by Captain Stiffe. The Amberwitch, in fact, acted like a guide to us, keeping us out of the deep water in which it was never intended to lay the cable.

I quote again from my report: "A little later we saw every indication of a squall from the W. N. W., which with very little warning burst on us about 7 P. M., accompanied by a little rain, some lightning, and a fearful quantity of fine sand, which enveloped us in such solid darkness that we could not see even a trace of the Zenobia's lights, although she was close under our bows, the hawsers being so slack that Lieut. Carpendale thought we had cast them off. Both ships broached to, in spite of their helms, and the Assaye, with her helm hard up, and the fore-topmast staysail set headed for some time due north, or nearly at right angles to her course. Before the awning could be furled the foremost part of it, which has no stanchions between the mizzen and main rigging, to which it extends, had been caught from underneath by the wind, and bellying up into an arch reaching nearly as high as the mizzen-top, then, with a report like that of a heavy gun, carried away, snapping all the strong iron stanchions abaft the mizzen-mast short off like carrots, carrying them up into the air and dashing them down on deck on the leeside of the brake machinery, burying the latter in the wreck. Fortunately, and almost miraculously, although the quarterdeck was crowded with the 'watch below,' just called to attempt to furl awning, no one was hurt. During this time the ships were being blown along at the rate of 8½ knots, as indicated by the brake, which was revolving at the rate of 45 revolutions a minute. Fortunately, the ridge chains, awnings, and ropes were cleared with great smartness by our men from the brake before anything caught on the cable itself, although for a considerable time the ridge chain was actually resting on the revolving drum. During the whole of this time all communication with the Zenobia, which we had hitherto kept up so successfully by means of the telegraphic lantern, was entirely cut off by the intense darkness, the last message sent before total eclipse being one from myself to Lieut. Carpendale, requesting him not to get blown into deep water. Fortunately, the squall had caught us on the port quarter, so that when we broached to we headed into the land. Had it caught us on the starboard quarter we should have headed seaward, and might have got off into deep water. For a short time during the commencement of the squall the Zenobia was on our weather bow, but she shortly afterward drifted to leeward, where she was when we first attempted to telegraph after the squall had moderated. It was fortunate that the squall did not occur a couple of hours later, as in such case we must have let go the end without buoying it, as it would have been impossible to head the ships to the wind or check their way in any manner sufficiently to attach the buoy chains, and we should have only been able to leave buoys near the end, which would have involved grappling for the cable afterward. The wind died away nearly as rapidly as it came, and at about 10 P. M. there was scarcely any, and that little heading us. As soon as we had only one mile left in the hold a blue light was burnt from the Assaye, which, had the wind been otherwise than ahead, was the signal for the Zenobia to round to head to wind, but this evolution was now rendered unnecessary by the wind heading from N. N. E. When half a mile was left in the hold I eased and stopped the Zenobia, and dropped our fore-topsail to check our way, and attached the first buoy at about a quarter of a mile from the end. Giving the ships a little way and checking again at the right moment, the buoy on the end was attached, and the end was successfully let go at 10:30 P. M."

We went into Oormara bay, and on the 7th the Cospatrick, the last of the five sailing ships with cable, arrived in tow of the Semiramis. On the 9th I went out in the Amberwitch to find the buoys. One buoy, the one on the end, was gone; but by means of the other buoy, cutting, etc., we got the cable end on board the Cospatrick, which ship had arrived out in tow of the Zenobia. We then attempted to make a joint between the core of the cable laid and that of the cable in the Cospatrick. I will here quote again from my report to Lieut.-Col. Stewart:

"We here, however, experienced the same difficulty in making the gutta-percha joint as we had during the repairing operation between Fao and Bushire, and which I have fully detailed in my report to you on that expedition. After trying to make several joints, and cutting off all the spare cable of the submerged portion without success, we found it impossible."

I consequently passed the end of the submerged cable back to the Amberwitch. We picked up mile after mile, cutting and trying to make a joint without success, the air left between the gutta-percha and the copper conductor being always squeezed out, and making the soft gutta-percha into a bubble. At last we tried a plan suggested by J. Laws, which answered perfectly.

I now quote again: "It seemed feasible that if we could stop the air from oozing up from the submerged cable by throttling or choking the cores immediately on each side of the joint, the formation of bubbles could not take place. The plan suggested by Mr. Laws consisted in having four pieces of hard wood, about six inches long and about 1½ inches thick, having each a semicircular groove in them, running longitudinally and rather smaller and shallower than that which would fit on to the gutta-percha covered wire. These were then clasped in pairs on the two portions of core to be joined about two inches from the ends to be joined, and then lashed tightly together with all the force that a 'Spanish windlass' in the hands of a sailor can apply, so that the gutta-percha was squeezed up tightly in every direction to the copper wire, thus preventing the passage of any air."

This plan succeeded perfectly, and does great credit to J. Laws. We again spliced on to the cable in the Cospatrick, and payed out towards Moiree, near Kurrachee. The cable we knew could not now reach within 10 miles of the landing place. We accordingly buoyed the end as usual. Afterward we landed the end of the shore-end cable from the Amberwitch by means of paddle-box boats, and paid out to the buoys, and made the final splice on the 15th, thus completing the cable through to Fao.

I have endeavored to give a sketch of the laying of the Persian Gulf cable of 1864, but, of course, it is not a detailed account, as that could hardly be given within the limits allowed me.

The Board of Water Commissioners of Madison, Wis., is considering installing a small electric plant to light the pumping station, the estimated cost being $350. It is also suggested to put in a plant large enough to light the city buildings as well as the water station, but the board does not favor this.

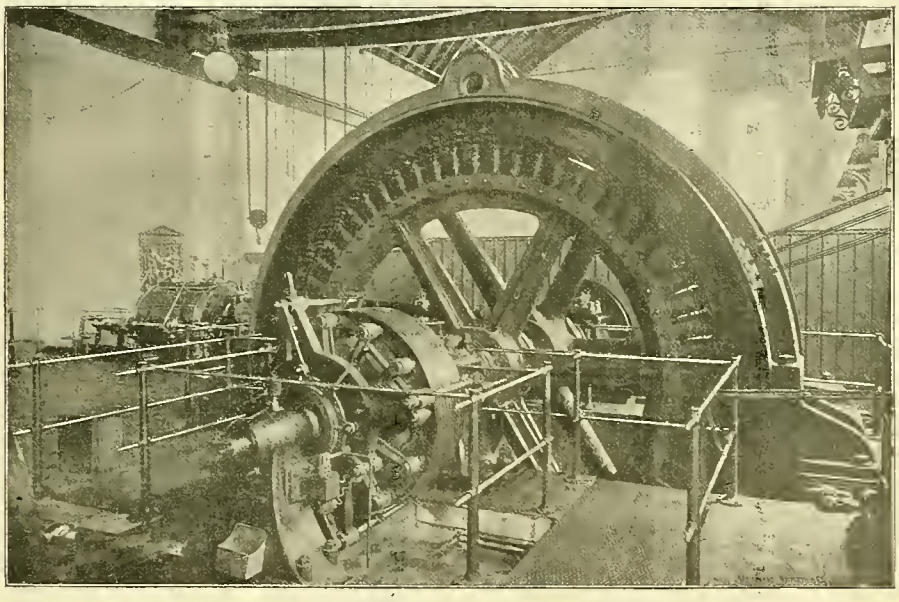


FIG. 3. THREE-PHASE WORK IN GERMANY.—ALTERNATOR AND EXCITER.

Three-phase Work in Germany.

During the latter part of the year 1894 the steam railroad authorities of Dresden installed at their passenger station a system of electric lighting and power which possesses some novel features. The nature of the distribution employed is that of triphase currents, modified for power purposes by means of reducing transformers at the point of departure and also at the points where the current is utilized. Difficulties in considerable numbers

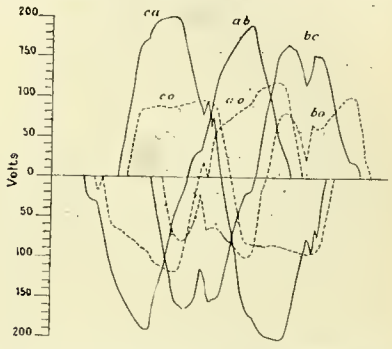


FIG. 1. THREE-PHASE WORK IN GERMANY.

presented themselves; these rendered perfect regulation a serious question, because of the many irregular applications of power. It was at first thought that the variations in the three circuits would work to the detriment of the illumination, and the alternators were accordingly arranged so as to give the lamps a single-phase current, while the motors were run upon the three-phase current. The installation was first established for lighting with 150 horse power and the motors were afterward put in operation. The drop in voltage was too great to be neglected. Then the triphase plan was suggested, the motors to be branched on three phases through an alternator, while another alternator, coupled with the first in parallel, but furnishing only a single phase, should feed the lamps. A special switch was provided for each machine, permitting of throwing to line a current of single or three phases.

This arrangement proved satisfactory, as shown by the curves (Figs. 1 and 2). In Fig. 1 the phase *a b* furnishes 95 kilowatts; phases *b c* and *c a* are both idle. Dotted line curves *c o*, *a o*, *b o* indicate the differences of potential between the extremes of the circuits and the point *o* in the coupling. In Fig. 2 the phase *a b* is carrying a load of 199 kilowatts and *b c* and *c a* are running light.

This was the plan of succession adopted in 1894. The day run consisted of a three-phase alternator and fed the motors and a few lamps in obscure places. At nightfall a single-phase alternator was thrown in, in parallel. The regulation proved perfect.

The dynamo room has within it a battery of five boilers, each containing 100 tubes of nine centimeters diameter. At a pressure of eight atmospheres each boiler can furnish 2,600 kilogrammes of steam per hour. City water is used and the tank is supplied automatically. Of steam engines there are four horizontal tan-

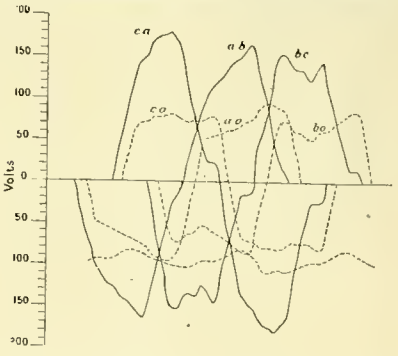


FIG. 2. THREE-PHASE WORK IN GERMANY.

dem compound machines, with capacity for 300 to 330 horse power at 100 revolutions, with steam at 7.5 atmospheres. The stroke of the piston is 0.90 meter; diameter of the high pressure cylinder 0.45 meter, and of the low pressure 0.75 meter.

The alternators furnish a maximum power of 220 kilowatts with a difference of potential of 150 to 220 volts and at 50 periods per second, in triphase currents, star coupled. The alternator is well shown in Fig. 3. The exciter is shown in front coupled to the same shaft. Each dynamo has a capacity of 182 amperes at 110 volts. One direct current machine serves for the four

alternators. The exciter circuits end at the switchboard and may be coupled in multiple. Each circuit is furnished with rheostat, carbon switch and a current indicator. A motor regulator of the engine is part of the equipment.

On the switchboard the bus-bars are 1,200 to 1,800 square millimeters section. On the lower part are the field circuits, the switches, cut-outs, ammeters and rheostats. In the center is a voltmeter and switches for the circuits of switchboard, meter room and central station lamps. The exciter circuits, indicators of current, rheostats and the carbon switches are above. The induced circuits of the alternators, with their cut-outs, are connected to the three bus-bars. Nine transformers of 100 kilowatts are fed from the three bars, which raise the potential from 115 to 3,118 volts. Upon the secondaries are switches and cut-outs for high tension. These circuits are again united to form three distinct groups and lead to three bars. There are also voltmeters and ground detectors, and a reducing transformer, the secondary of which serves to indicate the potential difference. The circuits then pass through meters showing the electrical energy, and having passed through another lot of switches, current meters and cut-outs, they are divided into 10 distinct groups, each composed of three cables. The first supplies the shops, the second the wharf, the third the old city depot, the fourth the new city depot, and the fifth the Friedrichstadt depot. All the apparatus is connected in such a way that all forms of combinations are easy to make so as to properly divide lighting and power service.

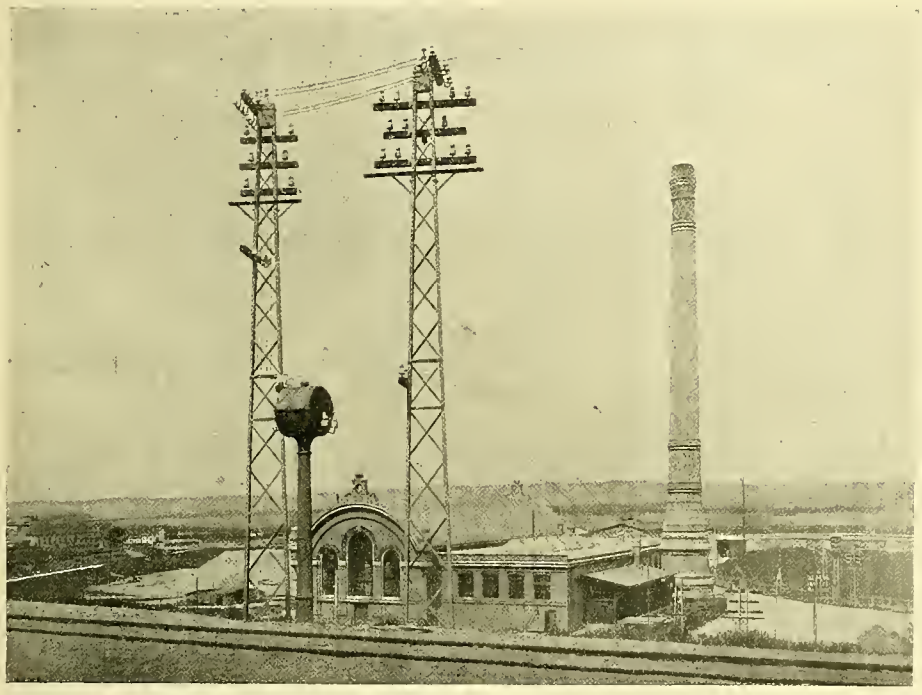


FIG. 4. THREE-PHASE WORK IN GERMANY.—AERIAL WIRES AND SERVICE TRANSFORMER.

The step-up transformers are mounted on porcelain. Leaving the transformers the high-tension circuits cross switches on a special board. In the laboratory and meter room are found everything necessary for electrical and photometric measurements.

The five centers of distribution are fed each by two circuits of three conductors. These three cables are buried from the dynamo room to the towers, about 40 meters, from whence the wires are bare. This arrangement is shown in Fig. 4. The bare wires are carried on porcelain insulators. Arresters are placed at intervals along the line. The transformers furnishing current for power are of 10 kilowatts and are placed on iron poles, as seen in Fig. 4. The loss in volts on the principal circuits is two per cent. and in the distribution circuits one per cent. The total service covers an area of 1,400,000 square meters, the farthest point being six kilometers from the station.

The central station is lighted by eight arc lamps of 15 amperes, two of 20 amperes and twenty 16 candle power incandescent lamps. The depot has 207 arcs and 780 incandescent lamps; 70 arcs are outside along the drive. The arcs have a pressure of 37 5 volts and the incandescent current is of 75 volts.

The motor service in the shops comprises traveling cranes, boring and turning lathes, presses, bellows, elevators, etc., to the number of 40, having a total of 152 horse power, the maximum load seldom exceeding 70 horse power. There are 40 motors in the construction department, and for handling and hauling material there are several more, including three of 23 horse power, one of 10 horse power and others smaller. The total expense of the installation was 2,160,375 francs and the output per month averages 34,000 kilowatt-hours for light and 11,000 kilowatt-hours for power purposes. The facts are taken from *L'Industrie Electrique*.

Emergency Work on an Electric Railroad.[1]

By Clarence H. Stilson, Jr.

With the advent of the electric railroad has sprung up a calling in which a great deal of ingenuity, fearlessness and self-confidence is required, namely, that of emergency lineman.

No doubt some of us have been out on a blustering night on some of our thoroughfares through which the trolley cars pass. A car passes swiftly along and our attention is not particularly attracted to it. Suddenly there is a brilliant flash of light, a rending crash, the lights on the car go out and deadly live wires writhe about the former peaceful street. Now and then the wire will perhaps come in contact with the rail and the arcing blinds us for the moment. The passengers are carefully led by the motorman or conductor through the tangle of wire to a safe spot and vehicles are motioned back from the dangerous locality. Word is sent to the power house or car house, as it may be, for the emergency wagon. A throng has gathered meanwhile and a rumor flies about that the accident was due to the trolley slipping from the wire and catching in a span wire. The blame, it seems, lies with the conductor, who should have been at hand to grasp the trolley rope. But the event is one full of incidents. A block-headed driver takes no notice of the violent gestures to turn back and in a moment the horse lies on its side, thrown down by the heavy current, the passage of which through its body being made more easy by contact through its iron shoes. In falling the poor beast has perhaps struck another deadly wire and the bystanders soon detect the odor of burning flesh. The situation, as we see, is one adapted to make good use of one's presence of mind.

In an incredibly short time down the street dashes the emergency wagon, the horses put to their utmost and the wagon itself swaying from side to side. It reminds one of an urgent fire call. The gong rings and at the last moment the brake is put on and the horses drawn back upon their haunches. The foreman issues his orders calmly to the one or two men accompanying him. A rope is thrown about the horse and he is dragged from the wire. The foreman himself having put on a pair of rubber gloves seizes a large pair of cutters and, protected thus from the current, cuts away the tangle of guard and span wires from the main trolley wire. Seizing now an end of this, he fastens on it a clamp. The clamp consists of two oblong pieces of metal, connected by four tap bolts, one side ending in a hook. A similar clamp is then fastened on the other end of the wire. A block and falls is hooked on, the two ends drawn together and temporary contact made so that that portion of the line may not become stalled. This has brought the two ends up in the air, and, if the strain has been sufficient, up to the former level.

In this case rubber gloves were used. Often they are not at hand and the danger is thus increased. But by the use of a dry board or box placed on the ground to stand upon, wires carrying currents of quite high voltage may be safely grasped by the naked hand.

The process of picking up a live trolley wire is simple when told in words, but usually hindrances arise and it is not until the wire is safely above ground that the linemen feel that they have accomplished anything. A little carelessness, a misstep, and one's teeth chatter as he feels the current take hold of him. For it comes in an instant and one does not know which is a safe wire or which is unsafe. Oftentimes does the current make its way through the body, sometimes entering at the hands and passing out through the shoe nails. But the more usual and dangerous shock is from hand to hand through the chest. A thousand demons seem to have entered you.

Now the crowd has separated and the men and wagon return. Next morning the repairing will be done.

Returning from the call, the eye of one of the men has perhaps caught sight of a place where the trolley wire has fallen from one of its points of suspension. A ladder is raised against the span wire and the ear examined. Very likely it has become so worn from the frequent passing of the trolley wheel that its renewal is necessary. Innumerable small details such as this give little time for idleness to the lineman. For instance, a circuit-breaker needs inspection and repair, a motor on one of the cars is burnt out, the feeder wires have chafed against the trees causing leakage in wet weather.

But next morning, accompanied by the tower wagon, the emergency wagon arrives at the scene of last night's trouble. The tower wagon is raised to the required height and drawn under the broken wire. Turnbuckles now replace the rope tackle, and a strain put on the wire which will give some slack for ease in working. Meanwhile a fire has been lighted in a charcoal furnace and the solder pot put over. A sleeve and the tools used in connection with it are brought up into the tower. The sleeve, used for joining the broken wire, is of circular cross-section, tapering from the middle down to a diameter, at each end, of little greater than that of the trolley wire. A hole to receive the end of the wire is in each end and extends coaxially toward the middle, before reaching which it curves and comes out at the side. The ends of the severed wire, having been scraped and cleaned, are now thrust into the sleeve and solder poured in through the holes at the side. Solder is also poured on the outside of the sleeve. By this means the sleeve is heated sufficiently to enable the molten metal to flow through the entire length of the whole without hardening. This insures a better joint as it brings the solder in contact with the wire and interior of the sleeve throughout its whole length. The joint thus made will be as strong if not stronger than the wire formerly was and the shape of the sleeve renders the passage of the trolley wheel quite smooth.

Such is the work which these men are frequently called upon to perform, rain or shine, day or night. And like all out-door work it hardens the muscles and broadens the chests of those engaged in it. Linemen are a sturdy set of men.

1. From the *Yale Scientific Monthly*.

Good Prospects on the Coast.

The *Pacific Electrician*, after making the general statement that it has been many years since the prospects for business in California have been as good as they are at present, goes on to particularize as follows:

The Valley railroad will spend $6,000,000 in the construction of new lines.

The Southern Pacific is preparing to complete the gap on its coast line and will undoubtedly spend a large sum of money during the coming year.

A new railroad is being surveyed into Stockton and there is talk of railroad work in Southern California.

The sustaining of the Wright irrigation law, while it will bear hard on some property owners, will at once lead to the investment of many millions of dollars in irrigation works, some of which will be accompanied by electric power transmission plants. Just how much will be spent in this way it is impossible to say, but $8,000,000 worth of bonds have been issued and will now be sold in order to carry out the projected work, while undoubtedly other irrigation districts will be formed.

In the mining field work is going ahead by leaps and bounds, more than twice as many men being employed as there were a year ago, and another year will see the number again doubled. Home capital and foreign capital, in small and large sums, are going into mining, and there is every evidence that a great many millions will be invested in the next few months.

In addition to all this the prices of agricultural products promise better returns to the farmers than for a number of years past, so that the whole state seems entering upon an era of great prosperity.

This will lead to a great increase in the population of the state and general activity in all lines of business.

The electrical industry has felt the depression of the past four years less than most, and, with a general return of confidence and prosperity, will undoubtedly experience its share of the good times.

The American Loan & Trust company of New York has brought suit to foreclose on the first mortgage bonds in the sum of $300,000 on the Burlington (Iowa) electric street railway, together with six per cent. interest unpaid since July, 1895. Local capitalists have been buying up the bonds at low figures and will bid in the property for reorganization.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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SEVERAL correspondents assure the WESTERN ELECTRICIAN that the Chicago Electrical Credit association is in active and beneficial existence, but that the fact has not been bruited abroad, to avoid "unpleasant notoriety," as one gentleman expresses it. There seems to be no reason for making a secret of the existence of an organization having such a healthful and laudable object.

THE condition of affairs in the electrical department of the city of Chicago under J. P. Barrett is well shown by the exposé, given on another page, of the manner in which it was proposed to award the fire-alarm contract. The matter has also been ventilated in the daily press, and it is promised that the agitation will be kept up. Such a complete disregard of right and justice is shown, and such reckless waste of the people's money was attempted, that even if no charge of corruption or collusion is made, the taxpayers should force the resignation of a man like Barrett, who is obviously unfit for the responsibilities of his position. His attachment to his "friends" is fatal to the interests of the public.

WHEN the case of the Milwaukee Street Railway company against the city came up for hearing in the United States Court at Milwaukee last Monday, the injunction restraining the city from enforcing the four-cent fare ordinance, passed last June, was continued for eight months, in order to afford opportunity to collect evidence upon the subject. The grounds upon which the city bases its claim to authority to make this regulation and the arguments of the company in opposition have already been outlined in these columns. It is now proposed to make a thorough examination of the subject, with the view of determining whether municipalities possess legal authority to make such regulations at will, and also whether a four-cent fare is a reasonable compensation.

MEN who have contributed to the success of the Niagara Falls power development project, and those whose interests will be affected by the successful transmission of the current from the Falls to Buffalo for use in the industrial occupations of the latter city, will "commemorate the introduction of Niagara power into the city of Buffalo" in befitting manner next Tuesday evening. One feature of the celebration will be a banquet at the Ellicott Club, Buffalo, where many notables in the world of finance and commerce and public men of distinction will assemble to mark the event with feasting and eloquence. The gathering promises to be unique in many respects, and it will have especial interest to electrical people everywhere.

COMPETING telephone companies have, in Indiana at least, the right to make use of the connections of their rivals. In other words, the statute provides that "every telephone company shall, within the local limits of said telephone company's business, supply all applicants for telephone connections and facilities with such connections and facilities, without discrimination or partiality." The law is upheld in a recent decision. On November 6, 1896, the Supreme Court of the state held, in the case of the Central Union Telephone company against Fehring, that merely furnishing an applicant with an instrument and connecting the latter with the exchange is not a compliance with this statute. After the telephone instrument is furnished and connected with the exchange, the court insists that it is the duty of the telephone company each time, when requested by the subscriber, to make such connections as will enable him to converse with the person named, without discrimination or partiality; and, for a refusal so to do, it becomes liable to him, as provided in the statute. This decision is of great value to the anti-Bell interests in that state, as they cannot be discriminated against in making use of the service of the older companies.

ONE has often to hearken to faraway sources to get the news from home. Thus a newspaper in Newcastle, England, in dwelling on the intimate relation of electricity and agriculture in the United States, where "electric plows, harrows, drills, carts, reaping and binding machines and even contrivances for forcing are at the disposal of the husbandman," casually mentions that "several electric farms" are already in existence. One, it seems, is "in the neighborhood of Chicago," and "power is derived from the river." Not only that, but there is "in the West a 15-blade plow which will cut a furrow six feet wide." This plow, certainly worthy of attention, "is also actuated by water." These items of information are delightfully indefinite; but what we are especially interested in is that river in the neighborhood of Chicago that furnishes the power for the electric farm. What river is it? It cannot be the Chicago River itself? We had not heard of it, and yet why not utilize the mad, sparkling, rushing torrent for electrical power transmission? Strange that no one has thought of this before. But very likely the New York *World* is even now casting the information into shape for an "exclusive" illustrated article in that admirable repository of fact and fancy, its Sunday magazine supplement.

ONE of the most important topics to be discussed at the next meeting of the executive committee of the National Electric Light association will be the convention of that organization. The time and place of holding the next meeting will be fixed and other arrangements made. It is believed that a majority of the committee favors Chicago as the place of meeting, and there is no question that such a decision would be approved by a great majority of the members. There has been some talk about holding the meeting in Canada, but this is not generally favored for the reasons that the members do not want to make the journey and such a plan would not be favorable for the holding of an exhibition in connection with the convention. If the meeting is held in this city, members in all parts of the country can attend without great inconvenience, and a big show can be gotten up. Such an exhibition as is contemplated for this year can only be conducted in a large city where the expenses could be met by charging admission to the general public. There are many reasons to commend Chicago, but as the members of the executive committee have had experience in these matters it is not necessary to enumerate them here. Chicago will welcome the association, and we are confident that the organization will gladly accept the hospitality of this city.

UNDER the provisions of the proposed charter for Greater New York the electrical department will be merged in the "Department of Public Buildings, Lighting and Supplies," which will have for its head a commissioner who shall be a member of the "Board of Public Improvements." Provision is made for the appointment of a consulting electrical engineer who shall have personal supervision of the electrical work of the department. Among the duties of the commissioner of the Department of Public Buildings, Lighting and Supplies are those "of the making and performance of contracts when duly authorized for furnishing the city, or any part thereof, gas, electricity, or any other illuminant; of the use and transmission of gas, electricity, and steam for all purposes in, upon, across, over and under all streets, roads, avenues, parks, public places, and public buildings; of the construction of electric mains, conduits, conductors and subways, and the granting of the permission to open streets, when approved by the Department of Highways." The testing of gas and electric meters in the city is named among the commissioner's duties. It is provided that the subway system for electrical conductors may be extended under existing laws by the Board of Public Improvements to all parts of the new city. Contracts for lighting are to be made by boroughs. It will be readily understood that under the new charter the commissioner of this department will possess great powers and may have a great influence upon the future development of electrical interests of the city. It certainly behooves the electrical industries of the city to secure the appointment of a competent and intelligent official for the head of this department.

MR. ARMSTRONG'S annual reviews of electrical accomplishment are always interesting, and that for the year 1896, reprinted elsewhere, is no exception. They relate particularly to the year's doing in Chicago and the West, but include also, and necessarily, brief surveys of the whole electrical field.

As could not fail to be the case in an electrical retrospect of the year just closed, the X-ray is accorded the position of pre-eminence, as the investigation and exploitation of that form of radiation to which Prof. Röntgen directed the attention of the scientific world have undoubtedly constituted the most notable forward step of recent years in the study of the allied mysteries of electricity, light and heat. The discovery has a very real, practical value, too, in surgery, in the possible detection of adulterants and hidden flaws and for other purposes. But we think that Mr. Armstrong is inclined to be over-sanguine in considering as a likelihood that the employment of this widely heralded agency will enable the blind to see. In passing upon vague hints and very indefinite possibilities, where the raising of vain hopes is downright cruelty, the attitude of technical men—as least in their public utterances—should be one of friendly skepticism until the proofs are indubitable.

The steady advance of electric traction during the year was mentioned in this journal last week and is corroborated by Mr. Armstrong, who also shows clearly that he favors cheaper fares. The persistent work on the trolley conduit systems and their brightening prospects for 1897 do not receive the attention which they seem to deserve, although a pleasant reference is made to the Englewood & Chicago storage battery road. The advances in power transmission are briefly sketched, including mention of the important Minneapolis project, with which Mr. Armstrong is familiar. Under the head of lighting a rather mysterious reference is made to a one-watt lamp, while the experiments of Dr. Jaqués with carbon generators are regarded with respect and interest. The writer has, as usual, a good word for isolated plants and a severe arraignment of the telephone monopoly, and concludes with the reflection that, on the whole, the year 1896 was, electrically speaking, one of "general healthy growth."

Electrical Progress in 1896.[1]

By Chas. G. Armstrong.

Almost simultaneously with the beginning of the year 1896 came the announcement of the discovery of "Röntgen rays" by Prof. Röntgen, a professor of physics of the Leipsic university; that the old and well-known scientific toy, the Crookes tube, possessed a mysterious function which heretofore no one had suspected; viz., the power to penetrate substances which had heretofore been considered opaque.

Like most important discoveries, this remarkable discovery was made through a mere accident, but Prof. Röntgen had the knowledge to follow the analysis in such a manner as to be able to announce to the world the wonderful properties which lay in what he christens the X-ray, and which, in honor of him, the world has named "Röntgen-rays." Thousands of experimenters immediately seized upon the idea advanced by Röntgen, and hundreds of manufacturers have been able to improve upon the crude apparatus; consequently the X-ray is known to-day throughout the civilized world. This discovery marks a wonderful step in advance for the electrical world, and it builds up a new field for research, with the prospect of solving a problem which as yet has never been fully solved, the relation of the underlying principles of light, heat and electricity.

With the perfection of the apparatus has come greater perfection in results, such as more distinct outlines and a deeper penetration of the hitherto unknown.

The Röntgen ray is of the greatest assistance to the surgeon, as by its means he can locate a broken bone or any piece of foreign substance which may be lodged in the human body, thereby doing away with the necessity of the old dangerous, painful and exceedingly unscientific method of probing. At first the only way to obtain these results was by photography, as the X-ray does not directly impress the eye, but, thanks to the untiring energy of Edison and some of our other foremost American experimenters, a method has been found whereby the eye can readily detect the effects of the X-ray through the medium of the fluoroscope.

Next to receive the benefits of the X-rays are the mechanical arts, as by means of the ray flaws in a certain piece of material can be detected, and from recent experiments it is safe to say that still more remarkable results are liable to be obtained by means of this wonderful discovery—that is, making the blind see. It has long been known that the senses of seeing, hearing, touching, smelling and tasting have been accomplished by means of wave forms, which certain nerves have been educated to receive and transmit to the brain; it now seems possible that in the near future we shall be able to magnify these wave forms so as to make them recognizable by the brain; if so, other nerves could be trained for such service, as, for instance, it might be possible to transmit through the nerves of touch the sight wave, making it possible to see through the medium of the ears as well as by the eyes.

The year of 1896 has been but an acceleration of the steady, healthy growth of 1895; owing to the continued depression in business very little speculative work in this line has been done, the improvement being confined to strictly legitimate and absolutely first-class enterprises. The prevalence of hard times has caused the managers of the various plants to give close attention to the expenses, which means that in a great many cases it has been found advisable to throw out all old-style machinery, and substitute therefor more modern machinery, which will do the same work with less attention, and take less coal, with a consequent reduction of operating expenses; this has been illustrated in the case of the Lake Street "L" road; the management has found that the noisy and expensive steam engine could not be operated with the net economy that could be obtained by the use of electricity; it has therefore abolished all steam engines, and is using electricity throughout.

The street railway companies of Chicago have very greatly increased their electrical plants and multiplied their trolleys in every direction, until at the present time there are very few horse cars in use; it is safe to predict that in another year they will be retired from the field, being displaced entirely by the trolley. We have seen during the present year valuable franchises given to a new road—the General Electric—and it is to be hoped that it will be in full operation by the close of 1897.

The growth in the street railway work has been the adoption of a larger generator, a larger engine, heavier rails and better construction. There have been no innovations, no improvements in the way of new machinery, the advance being principally in the perfection of details.

Our hopes in regard to cheaper fares have not been realized in Chicago, although an ordinance recently passed provided a four-cent fare. It is to be hoped, however, that during the present year either cheaper fare will be had or some adequate compensation shall be paid to the city for the use of our already overcrowded streets.

No improvements of value have been made in underground trolleys during the year of 1896, a prohibitive factor being the great cost of construction and maintenance.

Storage batteries have not improved very much during the last year, the Englewood road being only in partial operation, but the promoters promise to demonstrate during the year of 1897 that the storage battery is a practical agent for street car propulsion.

During the last year the power from Niagara Falls was transmitted to Buffalo, and is now in successful use, operating a portion of the street railway system. Like all electrical work some slight difficulty was experienced at first, owing to the overhead construction, but at present 1,000 horse power is being successfully transmitted to Buffalo.

Some months ago at the electrical convention Niagara falls power was used to transmit a message over the telegraph wires completely around the world. This act, while somewhat unusual, was not nearly so marvelous as might be supposed; in fact, this might easily be accomplished by means of a very small engine, but the idea of having used Niagara Falls power for this purpose was a novelty and served to impress upon the public mind the great possibilities of electricity as a power discharging agent.

During the year 1896 the St. Anthony Falls Water Power company has constructed a substantial dam and arranged for the transmission of 10,000 horse power to the cities of Minneapolis and St. Paul; current to be used for general power transmission work, such as operating the entire street-car lines, mills, factories, etc. This plant is second to the Niagara Falls plant (which is capable of delivering 15,000 horse power), and will be when constructed, the first underground system in the world for the purpose of transmitting power; this plant being in contrast with the Pabst plant at Milwaukee, which is used for transmitting light only.

The year of 1896 has no innovations in the system of electric lighting; the alternating current system has advanced at a very rapid rate; incandescent lamps have been improved somewhat, and there is still hope of great improvement in this direction. The average incandescent lamp consumes from three to $3\frac{1}{2}$ watts per candle power; whereas it will be possible to manufacture a lamp that will consume but one-third of this an hour, which will mean that the same amount of coal will produce three times the amount now obtained, or one-third as much coal will produce the same amount of light.

Considerable advance has been made in the use of electricity for marine service, especially on men-of-war, and for more efficient coast defense; the modern man-of-war is now fully equipped with greatly improved electrical devices, which control the speed of the engines, the rudder, the manipulation of and electrical firing of guns, etc. Among the improvements of the last year, for coast defense, one which undoubtedly will prove of great benefit to many of our defenseless harbors, is what is known as the electro-magnetic sentinel; this device takes advantage of the immense magnetic qualities of the modern armor-clad vessels, the apparatus being so arranged that when an iron-clad vessel comes within proximity of it, a submarine mine is automatically exploded, thus changing the steel armor which was formerly considered its greatest strength into its greatest weakness.

One of the first steps in the direction of obtaining electricity direct from coal has been made by a Boston inventor during the last year; data furnished by expert tests made by engineers not connected with the development of the invention show an efficiency 12 times greater than any of the modern generating plants; these tests were made, however, on small carbon generators, which naturally would show poorer results than those of larger size; the next year promises considerable advancement in this line of work, and is looked for with great interest, as this is the goal for which modern science is striving in the development of electricity.

Isolated electric lighting plants are becoming more and more popular in Chicago, owing to the fact that they enable the owner of a large building absolutely to control his own lights, and at the same time save all the loss incidental to a large central station plant, including the expensive right of way, and the great liability of interruption, caused by the immense number of conductors ramifying through the various streets of the city.

There seems to be very little doubt as to what the final decision will be relative to the Berliner patent; several companies have begun turning out non-infringing telephones which have been very satisfactory; a decision against prolonging the life of this patent would of course be of great advantage to competing companies, making it possible for the public to obtain its telephones at very reduced rates.

The Chicago Telephone company still continues to hold its monopoly, and insists upon charging us twice what the service is worth as a minimum charge, and from $50 to $100 more than is allowed them by their agreement with the city, without the slightest protest on the part of the officials, although it is in their power to correct this evil immediately, but as far as I am able to learn no step has been taken in this direction.

During this last year the hook patent has expired; this patent has been a great stumbling block to competing companies; the act of hanging up the receiver or the ear-piece of the telephone in the fork at the side of the box disconnects by means of gravity the speaking portion of the telephone, leaving only the bell in circuit; this is a great convenience to the manufacturer, as it simplifies construction and reduces the number of wires that would otherwise be necessary without the use of the hook; this patent, having run its legal course, is now public property and can be used by all.

The last year has seen some vast improvements in the automatic telephone exchanges, which eliminate the personal equation known as "the telephone girl;" the subscriber simply presses a button corresponding with the number of the party he wishes to talk with, and is instantly connected with that phone, provided it is not busy—if it is, he receives a distinct signal; when he is through with the party he hangs up his receiver, which instantly disconnects his circuit, and leaves him ready to accept or make connection with any other phone on the exchange. This system is in very successful operation in many places, and is giving excellent satisfaction.

The "dime-in-the-slot" machine is an innovation of last year, by means of which the company is able to charge from $200 to $600 rental a year for a telephone which costs $10 to build and a service which costs $25 a year to maintain. Resolutions have been recently introduced in the City Council to investigate the company's right to build this telephone, and it is sincerely hoped that the committee will do its work thoroughly and well.

The most important electric lighting plant which has been built lately is that constructed by the West Park commissioners, Forée Bain, electrical engineer. This plant consists of 1,300 arc lamps, arranged at proper intervals over 60 miles of boulevards. The lamps are suspended from ornamental posts about nine feet above the pavement, and extend five feet into the street, in order to avoid foliage. This plant is modern in every respect, and is built with a view to high economy, all wires being placed underground. The generating plant which operates these lights is located at Garfield Park, and, taking it as a whole, reflects great credit upon the park commissioners and the engineer who designed it. One of the innovations of this plant is the handsome tower wagon, drawn by one horse, by means of which the lamps can be trimmed without the necessity of the trimmer climbing the poles, which is always difficult, and many times a dangerous feat.

In conclusion, the year 1896 has seen many substantial, permanent improvements, principally in the way of larger machines, and a general healthy growth in minor details, which all go toward making up a complete whole in any line of business.

I think the electrical profession during the last year—notwithstanding the fact that it was presidential year, and a very hard year in financial circles—has done much to allay the distrust which has previously existed against electrical enterprises; has placed itself on a firmer footing with investors, and otherwise added fully its share toward the encouragement of the return of that era of prosperity toward which we are all hopefully looking.

1. From the *Chicago Record*.

A Great Scheme.

In addition to the projects of the General Electric Street Railway company on the South Side and the Chicago Electric Street Railway company on the North Side, already noticed in the Western Electrician, the *Chicago Chronicle* asserts that two other companies—the Chicago & Worth Street Railway company on the West Side and an unnamed company to operate in the northwestern portion of the city—are to be organized to combine with the two already in the field, the whole combination to be opposed in a struggle for supremacy with the Yerkes surface roads and the Chicago City street railway. J. Pierpont Morgan and other prominent eastern capitalists are mentioned as the backers of the proposed coalition. It is also stated that the underground trolley system of the Love Traction company is to be used by all the companies in the combination for down-town streets, and that "the coming war is therefore not one of territory merely, but between overhead and underground systems." Such a struggle would certainly be "Titanic," as the *Chronicle* says, but it can hardly be considered as a possibility.

The "Western Electrician" at the Head of the Procession.

[From the *Pacific Electrician*.]

The Western Electrician has had at the head of its editorial columns for some months a little notice that does not seem to have attracted the attention it deserves from its contemporaries. The notice reads as follows:

"The Western Electrician's first special electric light convention number (dated May 9th) contained 7,576 square inches of advertising. For the same week the *Electrical World* contained 7,326, the *Electrical Engineer* 3,687 and the *Electrical Review* 3,375 square inches of advertising. The Western Electrician's advertising, therefore, exceeded that of the *Electrical World* by 250 inches, that of the *Engineer* by 3,889 inches and that of the *Review* by 4,201 inches. It exceeded the combined advertising of the *Review* and *Engineer* by 514 inches."

When New York saw that Chicago was increasing in size faster than she was, she met the difficulty by arranging to double up with Brooklyn and make a Greater New York. Unless the New York electrical journals adopt some similar device it looks as though they would never again be at the head of the procession.

Must Observe Care in Starting Cars.

As a general proposition, it is not negligence to start a street car before a passenger is seated, but the Supreme Court of Minnesota says that due care in starting it must be observed, so as to allow passengers a reasonable opportunity to get safely on board. If such care is not used, the carrier is negligent. Thus, the court affirms a judgment for $2,500 in the case of Miller against the St. Paul City Railway company on November 9, 1896, where it thinks there was sufficient evidence of the defendant's negligence in suddenly starting its electric street car before the plaintiff was safely aboard of the car, whereby she was injured.

European Electric Railway Development.

Hon Thomas Ewing Moore, United States commercial agent at Weimar, has forwarded to the State Department the following report on electric railways in Europe:

Locomotion by means of electricity is gradually gaining ground in the various states of Europe, though not to the same extent as has been the case in the United States, which could hardly be expected, considering the advance in construction and working of the different systems employed there.

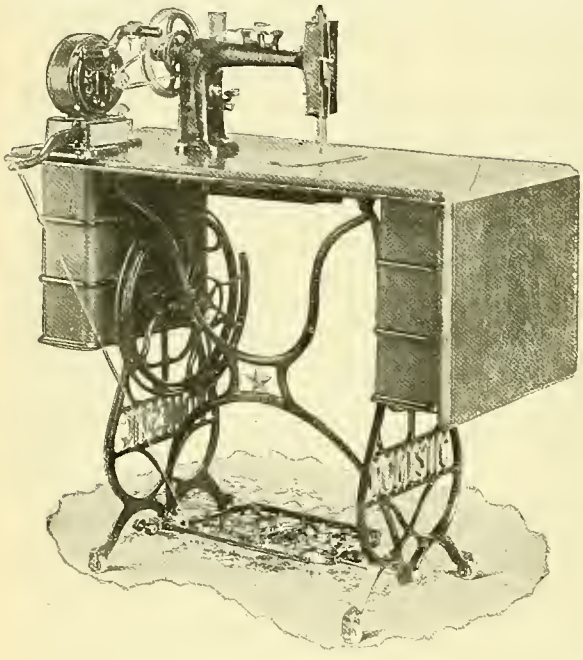
During 1895 the total number of electric railways or tramways in Europe rose from 70 to 111; the length of lines from 700 to 900 kilometers—435 to 560½ miles—and the power from 18,150 to 25,905 kilowatts, while the number of cars increased from 1,236 to 1,747.

In mileage of electric railways Germany is foremost among European nations, having 406 kilometers—252 miles—of lines; then follow France with 82 miles, Great Britain and Ireland 66½ miles, Austria-Hungary 44 miles, Switzerland 29 miles, Italy 24¾ miles; Servia, Russia, Belgium and Spain have but from 6.21376 to 18.64128 miles, while the remaining countries have less than 4.971 miles each.

Of these 111 lines 91 are worked by the overhead system, 12 on the underground system and eight by means of accumulators.

A large number of electric railways which were building during 1895 have been finished during 1896. It is estimated that the new lines of the present year will exceed in number and mileage those constructed in 1895, and it would appear from the activity shown in planning and laying out new routes that next year will show a like increase.

The capital invested in Germany alone in electric lines is estimated at 100,000,000 marks, or $23,800,000. German industry and German capital are responsible for the advance shown in this new departure, and it is also due in a great measure to the Rhenish-Westphalian iron industries having been for years trained in the production of street railway material both for the home and foreign market.



KENT ALTERNATING SEWING MACHINE MOTOR.

German electrical companies and supply manufactories have greatly increased in number and capital during the last few years, and are constructing electric lines and machinery to the smallest detail.

Among the larger cities Berlin is just about to introduce electric locomotion in its streets. At present it is almost entirely dependent on the old horse tramway and 'bus service. Hamburg and Leipsic have their electric street railways nearly completed.

The overhead trolley system, being cheaper than the others, will continue to be preferred for the lines contemplated or in course of construction.

Milwaukee-Racine Electric Railway.

Cars are running over the new electric railway connecting South Milwaukee and Racine, which are 17 miles apart. At the former place connection is made with electric cars running to and in Milwaukee, forming a part of the latter's street-car service. The new line has been under construction for nearly a year and is well built, with heavy rails and a rock-ballasted roadbed. The road will be used both for light freight and passenger traffic, but more attention will be paid to the latter. In all probability the freight will be carried at night so as not to interfere with the passenger business. Passengers will be carried from Racine to Milwaukee for 40 cents one way and 70 cents for the round trip. The fare to South Milwaukee will be 30 cents and 50 cents for round trip. These figures are just half of what is charged by the Northwestern steam road. I. N. Nelson, formerly superintendent of the electric line at Mount Clemens, Mich., is the superintendent of the new road. Three modern passenger cars equipped with vestibules are now in service. The new company has met considerable opposition from the Northwestern Railroad company, and was compelled to build a subway under the Northwestern's tracks at one place. The question of crossing the Northwestern track at South Milwaukee is now in litigation in the courts.

Kent Alternating Sewing Machine Motor.

The extended use of the alternating system of electric lighting has created a large demand for small power specialties for such circuits. The Kent Electric Manufacturing company of Worcester, Mass., has lately been bending its energies in this direction, and one of the results is a sewing machine motor illustrated by the accompanying cut.

The great difficulties encountered in this work are the small starting torque, and the non-variable speed of these motors. Both of these obstacles are believed to have been overcome in the device shown. The motor is mounted on a base, to move with a lever connected to the treadle of the machine, and the speed regulation is obtained by tightening and slackening the belt. By this method any desired speed may be maintained. In this way even more perfect regulation can be obtained than by direct current, as the speed can be changed in an instant, and the brake, which touches on the circumference of the balance-wheel, stops the machine instantly.

A switch located on the base is turned on when the operator sits down to the machine. The motor is thus started without a load, and is running constantly while the machine is in use. It is compact and neat in appearance.

This company has also perfected a new alternating dental engine which it expects to have on the market soon. It runs very quietly, and the speed at the hand-piece may be regulated perfectly.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

Chas. D. Johnson has bought the interest of F. H. Johnson in the telephone exchange at Tomah, Wis.

Fosston, Minn., will have a telephone exchange put in.

The Northwestern Telephone company has made connection between the Twin Cities and Waseca, Minn. This line will be extended in the spring to connect with Cedar Rapids, Ia.

Lamartine and Oakfield, Wis., have been connected by telephone at a cost of only $140.

The Fountain City, Minn., Telephone company will change its present instruments for long-distance 'phones.

The council of Mankato, Minn., has granted an extension of four months to the North Central Telephone company in which to have its system completed. The Blue Earth Valley company has its wires to the city limits and will connect with the former company.

The Wisconsin Telephone company will extend long-distance service from Milwaukee to La Crosse and the Twin Cities via Madison or Portage, Wis.

The Northwestern Telephone Exchange company and the Western Union Telegraph company at Faribault, Minn., have arranged to use the same poles.

Andrew Ryan is arranging to connect Shell Lake and Spooner, Wis., by telephone.

The Northern Wisconsin Telephone company has been incorporated at Gillet, Wis., and will at once build through Pulcifer, Cecil and Bonduel to Shawano, the line to be completed in 60 days. Later the line may be extended to Oconto Falls and possibly to Oconto.

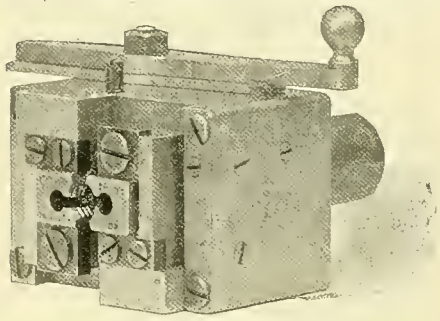
The Dane County Telephone company of Madison, Wis., is arranging to extend its system and will be able to take care of 150 more subscribers soon.

The Sunset telephone company will spend about $75,000 in improving its long-distance lines over the Cascade mountains, connecting Tacoma with Spokane and Eastern Washington. Work will be begun in the early spring.

The La Crosse & Southeastern Telephone company plans to connect with Madison and later Chicago by the independent companies between those points.

Richland Center, Wis., has an exchange of 75 instruments.

The Northwestern Telephone Exchange company has purchased the Rogers Block in St. Paul, in which its offices are located, at a cost of $50,000. Extensive improvements will be made on the building.



GARDNER DIE HEAD.

Superintendent Lomasney of the telephone exchange at Duluth, Minn., was injured by walking into an open trap-door. It is thought the injuries are not serious.

Gardner Die Head.

The Gardner No. 94 die head shown in the cut is built to as closely as possible approximate a solid die. This result is attained by using few moving parts and having those parts very stiff. The sliding die carriers extend across the full length of head, giving long wearing surfaces and much rigidity. The dies are closed by a taper pin forced into the back of the die carriers. It is claimed that this die head is as stiff and rigid as a solid die and will cut threads true to size, that wearing parts are few and will not wear out quickly, that it will not clog with chips, will do as fine and close work as desired, and that the cost of extra dies is small.

Chicago Edison Club.

Officers and employes of the Chicago Edison company met at the rooms of the Technical Club, 228 Clark street, on the night of December 30th, and formed the Chicago Edison Club. A dinner was the first thing on the program. Seventy was the number seated about the board, which had as its chief decoration the letters "C. E. C." in white immortelles, illuminated with tiny vari-colored incandescent lamps.

Following the dinner a number of speeches were given. L. A. Ferguson acted as toastmaster, and introduced as speakers the following-named, who talked of the new club and its prospects: John F. Gilchrist, Frank S. Gorton, W. L. Abbott, T. H. Creedon, John J. Abbott, L. L. Hills and F. R. Jenkins. After the speeches there was a short musical programme.

The new club will hold its meetings every two months. At these meetings at least one paper on a technical subject will be read. The object of the club will be two-fold—social and educational. Its membership will be limited to the department men of the company, and its affairs will be in charge of an executive committee composed of J. F. Gilchrist, H. E. Niesz, R. S. Kelsch, John J. Abbott, George Tailleur, C. G. Y. King, B. E. Strohm and Charles Holmes.

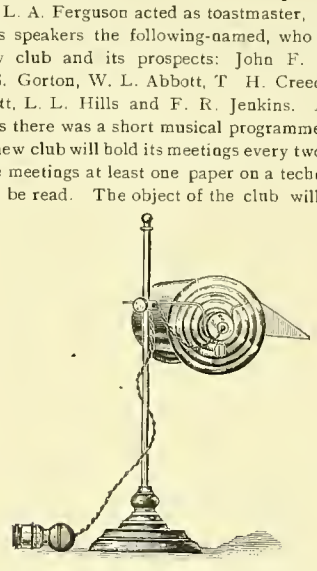


FIG. 1. ESPERSEN ADJUSTABLE SHADE LAMP.

The street railway company directors of Ashland, Wis., have decided to take up the line to Prentice Park and lay it toward the Driving Park.

Espersen Adjustable Shade Lamp.

Amoog the specialties that are attracting attention at this time is the Espersen adjustable sbade lamp, which is illustrated in the accompanying cuts. It is claimed that these lamps afford complete protection to tbe eyes, permittiog the light to be turned in any direction, and that it also increases the candle power one-half. This device can be used in any place or position where a good, bright light is needed. By simply turning the shade to a different angle, the light may be made dim or bright, and by revolving the shade toward the ceiling, a soft light may be obtained. In the sick room or bospital it can be used with good effect. It is claimed that if placed within two feet of a bed or a couch the light will not disturb a sleeping person, but will afford sufficient illumination on the opposite side to allow one to read the finest print. Fig. 1 shows the simplest form of the device with sliding standard. It can be ajusted to different heights like a studeot lamp. Jewelers, watchmakers, opticians, and others who use the light close to their work, find the lamp well adapted to their requirements. Another form is illustrated in Fig. 2, in which there is a desk attachment for roll-top desks or upright pianos. An attachment for fastening into electric light sockets, for chandelier, wall bracket or where the fixture is already installed is shown in Fig. 3. It can be readily adjusted and will allow the light to be thrown in any particular place, or the room may be darkened by turning the light at an angle. The application illustrated in Fig. 4 is made for those who desire to read in bed or a reclining position. It is made adjustable to bang over the head of the bed, and can be removed without trouble. These lamps have attracted attention abroad as well as in this country and the Pacific Electric company of La Crosse, Wis., which manufactures these devices, claims to have received many orders from England and the continent.

Fig. 2.

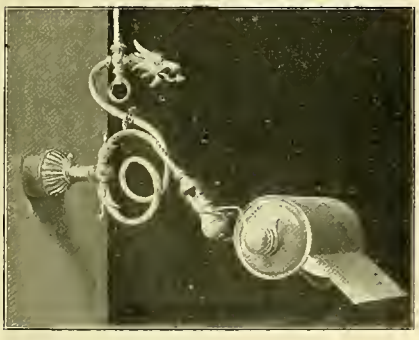


Fig. 3

Fig. 4.

ESPERSEN ADJUSTABLE SHADE LAMP.

Data of an Electric Switching Locomotive.

Electric locomotives are coming into use for switching purposes in steam freight railroad yards, and this service is likely to receive a marked impetus by the fact that one is now employed in connection with the New York, New Haven & Hartford railroad at New Haven, Conn. This locomotive is in constant service switching freight cars between the main line of that road and a number of factories located along the river front. The line over which it operates is about two miles long and is the property of several large manufacturers, the Bigelow company, manufacturer of boilers; the National Pipe Bending company, the Quinnipiac Brewing company, the New Haven Rolling Mills and others. It starts at the tracks of the New York, New Haven & Hartford railroad at Cedar Hill Junction, which is located about one mile from the New Haven passenger depot, and follows a devious course, throwing off sidings at each of the different factories. The track is of regular steam railroad type, with heavy steel rails, well ballasted and provided with switches and turnouts. In addition to the curves there is a 2½ per cent. grade against the load both ways on each side of Grand avenue.

The practice followed by the manufacturers hitherto in switching their cars has been for the freight engines of the railroad company to drop the cars at the junction; from that point they were hauled to the different factories by horses. This method was so slow, with the several curves and grades, and so hard upon the horses, that the manufacturers were driven to the conclusion that some other method of traction must be employed. Steam traction was rejected, for the excellent reason that the line runs for some distance along a frequented thoroughfare, where a switching engine would be a dangerous adjunct. That the steam locomotive would also be standing idle under steam for a large part of the day and consuming coal uselessly was also a weighty consideration. Electric traction was finally adopted as presenting many economical and other advantages, and an order was placed with the General Electric company for a 30-ton locomotive, which the company could guarantee would haul two loaded freight cars up a 2½ per cent. grade at a speed of seven miles an hour.

On December 8th the locomotive was delivered at New Haven and on the 11th it was put into actual operation without preliminary test on the line. Since that date it has been handling the entire movement of the cars between the factories and the Junction. On receipt of the locomotive the manufacturers painted upon the cab the words "Manufacturers' R. R. No. 1," and after two weeks' experience are extremely proud of their new acquisition.

The dimensions of the locomotive are as follows:

Weight	58,000 pounds.
Draw-bar pull	7,000 pounds.
Length over draw-bars	16 feet 6 inches.
Height over all	11 feet 6 inches.
Width over all	8 feet 3 inches.
Wheel base	5 feet 6 inches.
Diameter of drivers	44 inches.
Number of drivers (with cast-iron centers and steel tires)	Four.
Size of journals	5½ inches.
Gauge	4 feet 8½ inches.
Voltage	500.
Amperes, at full speed and normal draw-bar pull	600.
Amperes, at fair speed and normal draw-bar pull	300.

The motors are two in number, each axle being provided with its own motor. The motors are gearless and are supported upon a system of spiral springs resting on the side frames of the locomotive truck. The suspension being entirely upon springs, the wheels are free to adjust themselves to the irregularities of the road-bed and the wear and both tracks and motors is thus consequently diminished. In the armatures the iron-clad type of construction has been followed—that is, the windings are placed in a mica lined slot cut in the surface of the laminated core. The armature and commutator are upon a sleeve through which the axles pass. The sleeve rests in bearings on the motor frame. Two projecting arms from the sleeve fit into the openings in an iron plate loose upon the axle, and similar projections from the wheel enter the plate from the other side, so that, as the armature revolves, the wheels are revolved also. This coupling, being flexible, allows perfect freedom of motion. The commutators are of substantial construction and each motor has four sets of brushes.

The truck is constructed of I-beams and forms the foundation for a locomotive cab of sheet-iron with sloping shields at each end. It has two hinged doors, one on each side, and sliding windows at the sides, the front ones being stationary. As there are windows on all sides the motorman has a view in all directions. The interior of the cab is finished in cherry and contains the rest of the electrical equipment—automatic circuit breaker, controller, lightning arrester, reversing switch, air pump, air gauge, etc.

The controller is the L2 series, parallel type, arranged for the control of two motors. It is of the same general type as the K2, which is so familiar in ordinary street car practice, and is provided with separate reversing switch and the magnetic blow-out. The resistances are set beneath the shields and are of the packed ribbon type. The automatic circuit breaker is of 500 amperes capacity and involves also the magnetic blow-out principle, as does the lightning arrester, which is set upon the floor of the cab behind the controller. In the front of the cab and above the controller is a circular dial ampere meter reading to 500 amperes and facing the motorman is the air-pressure gauge. On the other side of the cab, opposite the controller, is an oscillating cylinder air pump, driven by a motor. This furnishes air to two air tanks suspended beneath the cab and is automatic in its action.

The air-pressure pump is controlled automatically by a pneumatic governor, consisting of a cylinder containing a piston working against a spring. The action of this automatic control is as follows: A pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upward against a spring. The other end of the piston rod carries the contacts through which the pump motor circuit is made and broken. When the pressure falls below that at which the automatic control is set the spring forces the piston down and the circuit is broken. Any arcs that may be formed when the contact is broken are blown out in the magnetic field. The locomotive is provided with a chime whistle blown by the compressed air, and a railroad headlight is set upon each shield. Beneath each one of the shields is an iron sandbox provided with pneumatic feeding device.

Electricity for this locomotive is furnished from the Fairhaven & Westville power house, which stands on Grand avenue about the middle of the line, and the current is taken by trolley from an overhead wire suspended from brackets. The operation of the locomotive is marked by extreme smoothness, and without load it can be run at almost any speed, and with load starts without jerk of any kind. It responds immediately to the motion of the controlling lever and can be backed up to a freight car for coupling as gently as the movement of a hand. One of the difficult duties it has to perform is the "kicking" of the freight cars over the curves in the New Haven rolling mill, in which there is one with a radius of only 50 feet. The locomotive can handle seven heavily loaded cars around this curve as easily apparently as it can two. Its operation is already attracting considerable attention from railroad engineers, several of whom have already visited the scene of its operation. In order to show one of these engineers what the locomotive would do, six loaded cars were hauled up the steepest grade with the slack all out, the start being made on a grade of about one per cent. One hundred and fifty amperes only were required to start this heavy train, and it moved off very smoothly and gradually.

One of the most interesting of Glasgow enterprises is what may be described as municipal time for the entire city. The scheme contemplates the establishment of a system of standard time, by means of electrically controlled clocks, regulated every second from the stellar clock at the observatory. If the trial proves successful, the corporation intends to erect from 200 to 300 eighteen-inch dials, thus providing a reliable system of standard time for all parts of the city. This extension of the circuit will involve the laying of 61 miles of wire. It is hoped also to include time-keeping in private houses.

Future Electrical Development.

In the course of an interview with a representative of the WESTERN ELECTRICIAN upon the outlook in the electrical field, Prof. Amos E. Dolbear of Tufts College, Boston, said:

"A searchlight, such as those shown in Chicago and elsewhere, can be seen 100 miles in clear air in the night. In murky or foggy air the light is quickly stopped, but the artificial Hertzian waves are not thus easily interfered with. Ordinary walls of wood or stone or brick are as transparent to such waves as glass is for ordinary light. A beam of such rays may be sent without the great loss which ordinary light suffers. As they can be directed by well-known means and received upon other electrical instruments quite independent of any wires or insulation, or connection with the ground in any way, it follows that we have a new method of doing telegraphic work, and that the work can go on when the eye can see nothing, independent of fog or rain. The limit to this in its present form is the curvature of the earth, but by zigzagging or tacking it can be theoretically carried to an indefinite distance, limited by the delicacy of the receiving apparatus.

"Another method of signaling will probably be in common use soon, namely, projecting a powerful beam from an electric lamp upon the sky or clouds as a screen. Such a shaft of light, if projected vertically upward, can be seen a long distance, and by making it intermittent a code of signals can be made to announce the coming changes in the weather. Indeed, this has already been begun. A few years ago when I suggested it to the weather bureau as a desirable way of announcing its forecasts, I was asked who would furnish the apparatus. That brought the discourse to a standstill. But the thing is to be used as an advertising medium, and one may now see in New York city upon the dark background of the cloud how many doses he can get for a dollar, alternating with the saintly countenances of Lydia Pinkham or the Old Judge—while the lightning plays about the pictures.

"Like the steam engine, the common incandescent lamp is a very uneconomical device. The steam engine gives back but five per cent. of the energy turned into it, and the incandescent lamp no more than five per cent. of what is turned into it, so between the coal and the light there is a great loss of the energy spent to produce it. It is evident there is here a great field for improvement. Whatever waves are given off by a lamp that are either too long or too short to affect the eye are wasted. That a high temperature is not essential for the production of light is evident from the fire-fly and the glow-worm, the phosphorescent light upon stumps and the persistent luminous streamers in the wake of large meteors, which sometimes last 10 minutes or more where the temperature must be many degrees below zero. All of our artificial sources of light employ high temperatures. When electrical discharges are made to pass into tubes from which the air has been mostly withdrawn the remaining air or gas is lighted up and may give out considerable light and yet not become appreciably warm. The efficiency of such light producers is high, for most of the energy spent in the tube appears as light. It has been known for a long time that such tubes are exceedingly sensitive and will light up without contact with the wire needed for other experiments. Simply being in the neighborhood of electrically excited bodies, as an induction coil, or plate glass machine, is sufficient. This means that 10 times as much light can be produced with a given expenditure of power by this device as by the method now employed. With such a system of lighting the ordinary apparatus and connections are dispensed with. Sheets of metal or gilt paper on opposite sides of the room are connected with the terminals of a suitable induction coil. The lamp may be an independent, portable thing as graceful and ornamental as a Greek vase. Whether it be lighted or not depends upon its position with relation to the walls of the room. If held horizontal, it may be lighted, if held vertical, it will cease to shine, and whether it be here or there in the room does not make much difference. With all this no one in the room need be conscious of electrical action, as such high frequencies produce no sensation.

"Electrical devices have been invented for cooking and heating and other household purposes. The mechanism is very simple, and regulation is as easy as turning a stove damper. An expenditure of one horse power is now needed to cook such things as griddle cakes three at a time, costing at ordinary rates about 10 cents an hour. This, of course, is much too costly for most families, but when the power is convenient and time more valuable than fuel and cook, the convenience will balance the higher cost. Heating rooms with an electrical current is entirely feasible, and the only reason it is not common now is its cost.

"But electricity can cool as well as heat. When a current is made to go through a thermopile the result is that one face is cooled and water has been frozen in this way."

Professor Dolbear next took up the subject of rapid transit, the influence of which upon the civilization of the future may be appreciated by those who have studied carefully the changes it has wrought during the last half century. "Fifty or 60 miles an hour," said he, "has been considered rapid transit, but we are now on the eve of a great change. Strength of mechanism to endure the strain, cost and safety alone are conditioning factors. It has been shown that on properly constructed roads one may be more safe at 60 miles an hour than on a poorly constructed road at 20 miles. The actual increase in cost of running at the higher rate is but a small figure, and in the substitution of the electric motor for the locomotive there is great advantage for speed in many ways. It is entirely probable that before long trains will be run at this rate between cities and with as great safety as with the present express trains. The completion of the Nantasket road and its successful operation during the past summer is likely to precipitate a rapid change in all railroad work. The sudden adoption of such a new method, which renders useless the present appliances, would, it is true, be ruinous to most roads in the country. Nevertheless, it may well be said that the time is close at hand when the steam locomotive will be as much of a curiosity as any old fire engine.

"Diamonds, sapphires, rubies and emeralds may be manufactured by a very simple process. Rubies and emeralds are but crystals, as snowflakes and rock candy. They are exceedingly hard and are fusible only in the heat of an electric furnace. They are composed of aluminum and oxygen. The substance is formed and crystallized in great abundance. When fused in an electric furnace it becomes as hard as the ruby and any color may be given to it. If not allowed to cool too quickly it crystallizes and may then be polished and has all the characteristics of a gem. Even now small transparent diamonds can be made at will by enclosing carbon made from sugar in an iron cylinder and fusing in an electric furnace, while fragments of rubies and emeralds are easily fused together and recrystallized again into large crystals, so that bits which before were nearly worthless can be worked into large and precious gems. A man can assemble the molecules under conditions where crystallization can take place, which it will do in the laboratory of Faust as it will in the laboratory of Vulcan. Faust, with a dynamo, can turn out as good a product as Vulcan with his forge, and if he be given encouragement will soon bring to the poorest in the land the most beautiful things, and will make the distinction between the rich to be only one of the quantity of their possessions.

"Electricity as an agency of the medical profession has a no less brilliant future than in the arts and in commerce, for the success which has already been attained warrants the conclusion that its application will quite supplant the common medical agencies for many diseases. It can act mechanically, chemically, physiologically. Each of these being quite under control, decomposition taking place here, recomposition there, material can be transfused into the body through the skin without rupture; poisonous material can be extracted from the body in a similar way. Anesthesia can be produced anywhere, so surgical processes can be carried on without pain or loss of consciousness, whether for tooth pulling or for amputations of any sort. Tumors and such abnormal growths have been reduced and destroyed by it. Metallic masses accidentally imbedded in the body can be located and needles extricated without even touching the skin. Electricity is also the bearer of energy, and it may be directed to any organ needing assistance without depending upon such a roundabout way as is always the case when a drug is taken into the stomach to repair, say, the lungs. A knowledge of electricity and its employment for physiological purposes will soon be a part of the equipment of every physician in every one of the numerous special departments into which the science is now divided.

"It is to be remembered that a pound of so-called nutriment differs from a pound of innutritious matters chiefly in the amount of available energy with which it is loaded. Electricity is an agency by which molecules may be loaded with energy, and the advance in both chemistry and electricity is of such a character as to warrant one in believing that ultimately all the bodily wants of man will be artificially supplied. Ideally one may go a step beyond this and in philosophic vision (not prophetic) see even how life might be maintained without foods of any kind in an organism adapted to absorb energy from space about it as a piece of matter gets warm in the sunshine, for it is beyond peradventure that all space within our ken is saturated with energy, that electrical energy is present in every nook and corner of creation and that there is no point in space where an abundance is not to be had if the demands of life should depend upon it."

The last subject touched upon was one interesting to every thoughtful and speculative mind, that of communication with the planet Mars. "A powerful searchlight," Prof. Dolbear ventured to say, "such as was exhibited at the Columbian fair, having the power of millions of candles, can be directed in a dense beam and can be made intermittent; signals can thus be sent the same as from the tops of mountains. Once out of the air there would be no loss from absorption and the beam would speed on, reaching Mars in about four minutes when it is nearest us. We have the necessary outfit; it only waits for the placing and patient testing. It may be drawing a long bow, but I venture to add that what I spoke of as Hertzian waves, of greater length than light waves, can in like manner be directed to Mars or elsewhere, and there is nothing in the nature of things to hinder electrical signaling between planets.

"These," said Professor Dolbear in conclusion, "are but a few of the things we are to look for which will so transform business methods and habits of society that all will be made over, for electricity is a genius that can do any and all kinds of work, and when all drudgery can be handed over to mechanical agencies man will then have the leisure he has sighed for so long."

CORRESPONDENCE.

New York Notes.

NEW YORK, January 2.—The news that the Metropolitan company is to equip two important north-and-south lines with the trolley conduit system now lacks no detail of corroboration, and so the new year begins with a very interesting and important departure in street railway work in this city. Some of the contracts for the new equipment have been already awarded. General Electric apparatus will be used.

A new route has been mapped out by the Rapid Transit Commission, which held an important meeting on the last day of the old year. President Orr describes the new plans as follows:

As a result of a very careful study of the rapid transit problem in this city, the Rapid Transit commissioners have agreed, provisionally, upon a route beginning at the South Ferry, and running thence northerly as a two-track railroad along Broadway and Park row to Chambers street. From Chambers street the route proceeds northerly as a four-track railroad under Elm street and Fourth avenue to Forty-second street; thence westerly under Forty-second street to Broadway, and thence northerly, under Broadway and the Boulevard, to One Hundred and Fourth street. At One Hundred and Fourth street it is proposed to divide the railroad into two two-track branches, and that the westerly one of these branches shall be carried to the north under the Boulevard, Eleventh avenue, Elwood street and Broadway to a point in Kingsbridge immediately north of the Harlem river. At this point a convenient connection could be effected with existing railroads running north. The easterly branch, starting at One Hundred and Fourth street and the Boulevard will run in a northeasterly direction under private property, One Hundred and Sixth street and Central Park to Lenox avenue; thence northerly under Lenox avenue to the north side of the Harlem River, and thence to Bronx Park. It is also proposed that there shall be appropriate loops at the South Ferry and City Hall Park. The plan of construction proposed is an underground road from the Battery to One Hundred and Ninetieth street on the West Side, except across Manhattan Valley and on the East Side across the Harlem River, to a point east of Third avenue. Beyond these points it is proposed to build an elevated road. The Harlem River would be crossed in a tunnel near the end of Lenox avenue and by a bridge at Kingsbridge. A railroad upon these lines can be constructed for somewhat less than $35,000,000, which seems to be the maximum permissible expenditure.

This route seems to have been published tentatively to sound public opinion. It will be observed that it is a combination of the overhead and underground systems, and, if carried out, both divisions should afford good opportunity to show the advantages of electric traction. The new commissioner, Charles Stewart Smith, elected to fill the vacancy caused by the death of William Stein-

way, attended the meeting. Mr Smith, who is widely known, is an ex-president of the Chamber of Commerce, and has been before considered for election to the board.

Gen. C. H. T. Collis, the commissioner of public works, lately returned from a trip abroad, and a page of the *Sun* is devoted to his observations. It is interesting to note his opinion that "no street lighting in Paris or London excels the Edison lamps on Fifth and Madison avenues for beauty or illumination." He adds that in localities remote from the hotels and private residences, where the humbler classes dwell, the lighting is not so good as in similar localities in New York, though the fogs of London render the best illumination essential.

By the disastrous fire in the central station of the Newark Electric Light & Power company on Tuesday night the people of that city came to realize the extent of their dependence on the electric light. This company supplies current to 2,250 arc lights and over 11,000 incandescents in addition to a motor service of 350 horse power. All of its 37 dynamos and the engines were ruined or badly damaged by the fire and water, entailing a loss estimated at $125,000. The company supplied the street lights, so that the city was practically in darkness. Long-disused gas fixtures, kerosene lamps and even candles were pressed into service, and in many places business was conducted at a great disadvantage. From store windows came the only light on the main thoroughfares, and some of the more enterprising shopkeepers added a picturesque aspect to the condition of affairs by swinging out Chinese lanterns. When the stores were closed there was almost complete darkness, through which the trolley cars moved like so many big firebugs. Extra precautions to prevent accidents were taken by the traction companies and their employes, and the police were on the alert to prevent burglars and highwaymen from taking advantage of the situation. From the Newark station the company supplied directly the power for lighting Harrison, Bloomfield, South Orange and Irvington. These places were in darkness, as well as Newark, though Harrison obtained relief in an hour or two, the company immediately renewing the connections with the plant of the Excelsior Electric Lighting company in that town, which was recently absorbed by the Newark concern. In the other places there was no relief, as there are no independent plants. The fire started early in the evening at the switchboard, but its exact manner of origin appears to be unknown. It is stated that a marble switchboard was formerly in use, and that wood had recently been substituted, but this seems hardly credible. The fire lasted for three hours. During its progress all trains on the Center street branch of the Pennsylvania railroad were stalled, and it became necessary to cut the Postal Telegraph-cable company's cable, which carries across the Passaic River all its wires to New York, thereby crippling its Newark-New York service until late in the night. Energetic efforts have been made to resume the service. The company worked manfully on Wednesday, and had 421 arc lights going on Wednesday night. As many more were in operation by Thursday night, and it is thought that all of the street lamps, numbering nearly 1,700, will be working by Monday night. Two shipments of dynamos arrived on Thursday. A trainload from Cleveland, O., consisting of 18 big machines reached Newark over the Erie three hours ahead of time. These dynamos were ready at the Brush works, and were awaiting orders. The order to ship them at once was sent as soon as it was assured that the fire would destroy all the dynamos in the building. The railroad companies gave the special freight a clear track and sent the train through on fast time. Four other generators were hurried through from the Stanley factory at Pittsfield, Mass., in a similar way, and they arrived in Newark at noon on Thursday. Another trainload was received from Fort Wayne. These machines have been set up in various places, where engines and boilers are idle, and will supply Newark until the power house is rebuilt. The Boyd street power house of the Rapid Transit Railroad company, which has been idle for some time, supplied 125 lights.

The Third Avenue Railroad company has just signed a contract with the General Electric company for the electrical equipment of the new extension from One Hundred and Sixty-fifth street and Amsterdam avenue to Kingsbridge. The line will run from the junction of Kingsbridge road and Amsterdam avenue at One Hundred and Sixty-fifth street via the Kingsbridge road to Spuyten Duyvil Creek, a distance of about two and a half miles. The overhead trolley system will be used. The poles will be of ornamental cast-iron, placed in the middle of the roadway, and every alternate pole will carry a 1,200 candle power arc light. The cars, which have been already ordered, will embody those improvements in construction suggested by the experience of the Third Avenue railway authorities on their present cable cars. The power house will be situated on the banks of the Spuyten Duyvil Canal at Two Hundred and Fourteenth street. There will be 15 Babcock & Wilcox water tube boilers, aggregating 2,500 horse power. The three Allis engines will be of 1,100, 700 and 500 horse power respectively, driving direct-connected generators. Work has already been begun on the power house, and the Third Avenue Railroad company expects to have everything completed and in working order by next summer. The estimated cost of the power plant is $100,000. The entire cost of the electrical equipment will be $250,000. M. S.

Northwestern Notations.

Minneapolis, January 2.—The General Electric Light & Power company of Le Sueur, Minn., has decided to abandon business there and will accept the offer of the city to purchase such of its plant as could be used to advantage in the municipal plant. This is the end of a bitter fight made against the city plant, the city attempting to freeze out the private plant by compelling it to remove its poles and wires from the streets.

Bathgate, N. D., may be electrically lighted soon.

The Madelia, Minn., flour mills will soon be lighted by electricity and this is considered an initiatory step toward lighting the city from the plant.

The Kammann Electric company has been incorporated at Minneapolis to manufacture electro-magnetic transmission devices. The capital stock is $250,000.

The power house of the Janesville, Wis., street railway plant was burned, with a total loss of $12,000; insurance, $5,000. The road will not be operated this winter as a result of the fire.

A stock company has been formed at Winnebago City, Minn., to handle the flour mill, and the company may put in an electric light plant to furnish the city light.

The Anaconda Electric Railway company of Anaconda, Mont., has improved its service and makes better time with its cars.

The De Pere, Wis., Electric Light & Power company is endeavoring to induce some manufacturing industry to locate there to utilize the company's water power.

The Arcadia, Wis., electric light plant has been completed and tested.

Everything worked satisfactorily at the trial of the Mt. Pleasant, Ia., electric light plant.

The Hastings, Minn., electric light station will soon be in running order again. It was burned last fall.

The Albert Lea, Minn., Electric company has increased its capital stock from $50,000 to $100,000.

Electric lighting is being considered in Belle Plaine, Minn.

The Menominee River Boom company contemplates building a dam at Chapple Rapids, seven miles from Marinette, Wis., where immense power could be developed, and transmitting it to Marinette by electricity. The dam would cost $50,000.

The Corning, Ia., electric light power house was burned. The dynamos have been shipped for repairs.

Correctionville, Ia., voted for an electric lighting plant.

Electrical experts have completed their report and submitted it to the Minneapolis & St. Louis Railway company on the cost of equipping its Lake Minnetonka line for electric cars on the plan of the Old Colony line.

Two years ago the city of Des Moines, Ia., granted a new franchise to the City Railway company, among the provisions of which was one that after January 1, 1897, the company should pay a five per cent. tax on its net receipts annually. The company has arranged its affairs so that there is not likely to be any net receipts, and the city officials say it is a confidence game. The street railway company controls by lease several lines that are owned by other corporations; the power house is owned by still another, the down-town depot by another, and all are leased to the City Railway company. The rentals for these various leased properties are heavy, and the owners of the stocks of the other companies are the same as those of the City Railway company.

The city of Fairmont, Minn., is considering an offer from the operators of the electric light plant to sell the contract for operating the electric light plant to the village for $5,000. The village owns the plant.

It is believed that the court will not discharge the receiver of the Stillwater (Minn.) electric street railway, but will continue him until spring, when it is hoped the plant will sell for enough to cover the indebtedness, $5,200.

Darlington, Wis., now has electric lighting.

The council of Great Falls, Mont., and the lighting company have got together on a $9 per light per month basis, and the city now has electric street lighting again.

The Quirk Milling company of Montgomery, Minn., has contracted with the D. & D. Electric Manufacturing company of Minneapolis for an electric plant to light the village. A 650 light plant will be put in.

There is talk of a proposition to light the city of Onalaska, Wis., by electricity.

A joint meeting of citizens and the council was held in Thorp, Wis., to consider the advisability of granting an electric light franchise to Henry Leibole. The decision was favorable and a committee was appointed to secure information from other towns on rates, etc.

E. B. Magill of La Crosse, Wis., has made a proposition to Hillsboro, Wis., to construct an electric line from that place to Union Center. Committees were appointed to work in the matter.

Litchfield, Minn., uses 800 incandescent electric lights.

H. G. Rich, an inventor of Des Moines, Iowa, has invented an electrical aerial torpedo for use in warfare. It consists of a small-sized hot-air balloon capable of sustaining a 30 or 40-pound dynamite case at 300 to 1,000 feet from the earth. Inside is a cylinder containing an electrical device to regulate the time the balloon shall remain in the air and to ignite gas at a stated period to release the dynamite case.

The Sandstone Supply company is an applicant for an electric lighting franchise at Sandstone, Minn.

The report of Forée Bain on the electric elevators in the court-house in Minneapolis is very voluminous. He recommends the separation of the electric lighting from the elevator system, the renewal of the batteries, and securing heavier engines in connection with the elevators. The court-house commissioners and the county commissioners are somewhat at sea in the matter, as the company that put the plant in insists that it is all right and suggests that the various accidents that have occurred are owing to some crooked work being done by enemies.

The mayor of St. Paul has signed the ordinance requiring the City Railway company to construct and operate the Broadway loop. The council is considering an ordinance ordering the City Railway company to change the cable line to electric, to be done by September 1, 1897.

The Malleable Iron company of Waukesha, Wis., is preparing to put in an electric light plant to supply 160 incandescent lights.

The council of Oskaloosa, Iowa, ordered the mayor to call a special election to vote on a franchise for an electric railway, which he refuses to do, and mandamus proceedings will probably be begun.

The original promoters of the interurban electric line from Neenah to Menasha, Appleton and Kaukauna, Wis., announce that arrangements have been completed for its construction, and that it will be in operation from Neenah to Appleton by July 1, 1897. Contracts for equipment will be let this winter, and construction begun in the early spring. The projectors of a similar line at Oshkosh say that it is simply a move to block their enterprise and that it will not be built.

Forée Bain and C. G. Armstrong, the consulting electrical engineers from Chicago, have been in Minneapolis this week going over in detail the bids on the great plant for the St. Anthony Falls Power company. The bids are from the General Electric company of Schenectady, N. Y.; the Westinghouse Electric & Manufacturing company, Pittsburg; the Stanley Electric company, Pittsfield, Mass.; and the Wagner Electric company, St. Louis.

The City Council of Seattle, Wash., has rejected all bids for electric lighting, considering them all too high. The committee was instructed to investigate the feasibility of purchasing dynamos. The city will get along without light until next summer.

The petition of A. M. Allen to the county commissioners of Hennepin county for the right to use the county roads for an electric line from Minneapolis to Lake Minnetonka produced considerable discussion. Residents of the vicinity of the proposed line opposed sacrificing the boulevard, and said that it would mean that the county would have to expend a large sum of money to put some other road in the same condition that the boulevard now is. It is reported

that the Minneapolis & St. Louis railroad and the Great Northern have both had their railway lines surveyed for running electric cars, using the third-rail system. The county commissioners rejected the petition.

There is talk among the business men of Knapp, Wis., of having electric lighting.

Litchfield, Minn., is considering bids for the purchase of a larger dynamo.

An electric light plant is to be put in at Eagle Lake, Minn.

A mass meeting held in Wadena, Minn., appointed a committee to ascertain the cost of the village operating the electric light plant in connection with a proposed water system. The matter will probably be voted on soon.

The Gladstone, Mich., electric light plant has been rebuilt and put in operation again.

A. A. Warfield, a Duluth electrician, found a piece of a broken needle in the hand of Mrs. John Warfield of Swan River, Minn., by means of an X-ray picture.

The Newton, Ia., electric light plant is completed and in operation.

There is a strong desire at Madison, S. D., for electric lighting, but there seems to be a lack of enterprise.

Dr. Strickler has made a proposition to the city of Reinbeck, Ia., to furnish electric light from his plant in Grundy Center.

J. C. Foley is interested in a project to construct a telegraph line from the Canadian Pacific railway to Sawbill lake, and thence down the Seine river to the town of Foley, on Shoal Lake, giving connection with the Rainy Lake gold region.

A St. Louis man has made a proposition to Redwood Falls, Minn., to put in an electric lighting plant to cost $15,000 to $20,000.

The city of Springfield, Minn., has contracted for an Ide engine to operate its electric light plant.

The Cedar Falls Electric Light company has been granted a franchise at Cedar Falls, Ia.

For the month of October the receipts from the Grafton, N. D., electric light plant were $500 and the expenses $350. This includes the cost of furnishing street lighting and operating the water works, so the town makes a good profit on the plant.

M. Riggs, an inventor in Seattle, Wash., submitted a fender for test to the street railway company, which tried a dummy on it, and ran over the dummy every time. The inventor charges that the dummy was not a fair test, as it was made top-heavy to fall in such a way that the car would run over it.

F. H. Wheelock of St. Paul has invented and applied for a patent on a device to enable electric railways to overcome grades. He claims it will mount any grade except perpendicular. It is on the cog-wheel and rack system. He would place a cogged strip or rack on the grade joining the rail. On the axles of the motor car and inside the ordinary wheels is to be fastened a pinion or cog-wheel and then a small flanged wheel. The device is so arranged that when the cog wheel is in operation the ordinary wheel is raised from the track half an inch. Four of the cogs would be applied at once so that a broken cog would not cause danger. C.

PERSONAL.

It is stated that the grandson of the Lord John Russell famous in English history was for some time connected with an electrical engineering establishment in London.

Secretary Mercein of the Northwestern Electrical association was in town last week. He is looking forward to a successful and important convention in Milwaukee on January 20th and 21st. Quite a large number of new members will be received and several important questions—among them that of municipal ownership—will come up, in addition to the interesting list of papers for reading and discussion.

The wide circle of friends of the American Electrical Works of Providence will be interested in the announcement that the two sons of President Phillips are now taking an active part in the management of the company. F. N. Phillips has assumed the position of treasurer, made vacant by the resignation of W. A. Hathaway, and E. Rowland Phillips has been appointed superintendent of the works.

Referring to the late J. B. McCullagh, the widely known editor of the *St. Louis Globe-Democrat*, Colonel Clowry says: "He worked himself to death. I never have known a man so devoted to his work. We were friends for 30 years or more, and during all that time his life was a perpetual grind. He was an ideal editor, and his ability to gather news amounted almost to genius. He gave his correspondents free rein and for many years the *Globe-Democrat* paid larger telegraph bills than any other paper in the country. McCullagh had no very intimate friends. He seemed to hold aloof from everyone, though he was naturally kind hearted, and I don't think that he was ever under obligations to anyone, socially, officially or personally. He was a free lance, absolutely without fear, but never bitter."

ELECTRIC RAILWAYS.

A party of Massachusetts capitalists has purchased the franchise of the Kittery, Kittery Point & York Beach Electric Railroad company, and the work of construction will be begun at once. It is expected that work will be finished by June 1, 1897. The same persons are attempting to acquire possession of the Portsmouth (N. H.) electric railroad franchise, to build both roads simultaneously.

The Walker company has commenced an assumpsit suit for $15,000 against the Glen Oaks & Prospect Heights Railway company, James H. Seiberling, Monroe Seiberling, A. G. Seiberling and Fred Patee, all of Peoria, Ill., for breach of contract. The Walker company contracted with the defendants for generators and motors, and without cause, it is said, the Glen Oaks company cancelled the contract. The Walker company is making a test case of this and promises to push it vigorously.

The Hyde Park Street Railway company of Hyde Park, Mass., is erecting a new power station. The boiler room is 44 feet wide and 87 feet long, and the engine room is 56 feet wide and 115 feet long. The building is to have brick walls and the roof is to be supported by steel trusses. The steel work has been designed and will be furnished and erected by the Berlin Iron Bridge company of East Berlin, Conn., which has also received the contract from Stone & Webster, engineers, Boston, Mass., for the steel work in the power plant for the Brockton Street Railway company at Brockton, Mass.

TELEPHONE.

For some time the Missouri & Kansas Telephone company has been at work on an extension from St. Joseph, Mo., to the north on the west side of Missouri river, which is to be used as a through line to Omaha, Chicago, New York and intermediate points. With the completion of this new line telephone service from Chicago can be extended as far west and south as Kansas City, Wichita, and intermediate points.

A report from St. Louis that the Western Union Telegraph company was to enter the telephone field in that city, using the new Kinlock telephone, is said to be news to the Western Union authorities in New York. At the same time no surprise was expressed, and it was said that, if the news were true, it was a local matter, rather than a move in pursuance of the general policy of the company. The Western Union company has secured control of several new patents, and it is said it may utilize them when it can do so to advantage. As to the use of telephones generally, the company is reported to be in a position to rent wires and put in telephones as cheaply as any company if it sees fit to do so.

TELEGRAPH.

A submarine cable has been completed from Emden, Prussia, to Vigo, Spain, which links the German telegraphic system with the South American and other systems. Capital has been furnished by an Anglo-German syndicate for the construction of the first section of a submarine cable between Germany and the United States by way of the Azores.

MISCELLANEOUS.

It is reported that a crucial test of compressed air as a possible rival of electricity has been made in a Colorado mine. The tests extended over a month, and were made in every case under exactly similar conditions. Two small electric pumps and an air pump were placed side by side in an entry 10 feet wide by five feet high, with the exhaust of the air pump, into which a stream of water was discharged to prevent it from freezing, venting so near the electric pump that it was necessary to protect the latter from the water by an oilcloth. This was a good test for the waterproof properties of the motors. The result of the trial showed that the work of pumping by compressed air, which had formerly called for 312 horse power and eight boilers, could be done by electricity with but 56 horse power and one boiler, disregarding even the use of a compound engine and a condenser. In other words, the whole plant of pumps and machinery heretofore requiring eight boilers, taxed to their utmost, can be operated by a modest electric plant, with but one horizontal tubular boiler. The total efficiency of this electric pumping plant is estimated as close to 60 per cent.

TRADE NEWS.

The Chicago agency of the Shawmut Fuse Wire company of Boston has been removed from 100 Washington street to 1511 Monadnock Building. Morris Metcalf is in charge of the office.

The Hine & Robertson company of New York has been succeeded by James L. Robertson & Sons. The same persons interested in the Hine & Robertson company manage the new firm. The death of F. A. Hine and the admission of Mr. Robertson's sons into partnership brought about the change.

"As an Investment" is the title of a strong argument for the use of good lightning arresters put forth by the Garton-Daniels Electric company of Keokuk, Iowa. "How many Garton lightning arresters could you have bought with the price of those armatures?" is the question asked of the street railway manager who has suffered from the effects of electric storms. It is a pertinent and important question, too.

General Manager J. P. Williams of the Paragon Fan Motor company of 39 Cortlandt street, New York, has just returned from an extended trip through the southern states. He reports having sold large advance orders for these motors; in fact, the company has been obliged to have its facilities increased nearly double in order to deliver the orders which are now received. This motor is well known for its efficiency, and without doubt will have a large sale this season.

The United Electric company of Springfield, Mass., is completing its new station at Indian Orchard and has placed an order with the Jewell Belting company of Hartford, Conn., for four 40-inch Jewell dynamo belts, each 70 feet long. This company, in its different plants, has thoroughly tested most of the more prominent makes of belting, and has placed this order with the Jewell company on account of the excellent records made by belts of this manufacture which have been in use a number of years.

The Partrick & Carter company of 125 South Second street, Philadelphia, known as a pioneer in the electrical supply business, has had an unusually prosperous year despite the general condition of business thoughout the country. Its supplies are well known to the trade as being standard, and the calls for burglar and fire alarms, signal gongs, etc., have been much greater than in any previous year. The company expects an increase of trade throughout the West, basing its anticipation on the many requests for quotations upon its various supplies.

Congratulations are being extended to the Clonbrock Steam Boiler company of Brooklyn, N. Y., on the award of the entire contract for boilers to be used at the Tennessee Centennial Exposition, to be held in Nashville, Tenn. This order was given after the very closest investigation into the merits of the one selected, and is evidence of the strong position which the "Climax" has achieved in the electrical and other industries. General Manager Stephen Morin reports that the factory is working overtime, as it has been for some months past, and that the busy season is already upon them for the new year.

The electrical trade will be interested to know that H. M. Underwood has been appointed consulting electrical engineer to Kallal & Molitor, architects of Chicago, and the electrical engineering of this concern will be entirely in his hands. One of the first installations to which Mr. Underwood will have to attend is the lighting for the Hotel DeCliff of Texarkana, Ark. Without going into the details of this installation it may be said that special features will be employed for the lighting of the hotel. No fixtures will be used in the bedrooms, the lights being placed close to the center of the ceiling, and holophane globes will be used throughout the entire building and in a manner that the engineer considers to be exceedingly novel. An isolated plant will be installed of the very latest and best type of machines. All the wires will be conduited, and an underground subway will be laid from the dining-room to the center of distribution for the hotel. Mr. Underwood expects to make this a model installation.

The Gates Iron Works of Chicago announce their embarkation in the high-speed engine business with the Fischer-Gates single and four-valve self-oiling automatic engines, built according to the design and under the patents of Fred F. Fischer. The product will be handled on the market by Fischer & Whiteside, whose headquarters are at 700-702 Fisher building, Chicago. Plans for extensive additions to the already large plant of the Gates Iron Works are completed, and it is intended to push this branch of the business with the energy, experience and business tact characteristic of this company, and a large trade is anticipated. The catalogue illustrating and describing the novel features of the Fischer-Gates engine, many of which are already familiar to the engineering fraternity, will be ready for distribution in a short time. The reputation of this concern and that of the gentlemen who are associated with it will insure a high-class machine and the most cordial and conservative treatment of patrons.

BUSINESS.

What would New Year's be without a cheerful rhymed greeting from "Charlie" Shain to his friends? This year he sent broadcast this admirable sentiment:

> A cheerful start, with your affairs well in hand;
> A spurt for the wire, and a winner you'll land.

A copper steer, of suitable size for a paper weight, is the holiday souvenir sent out by the Mitchell Tempered Copper company of Corry, Pa. This company manufactures pure copper castings for all systems of electrical apparatus.

The Merritt Electric company has removed its factory to Middleton, Mass., on the Lawrence branch of the Boston & Maine railroad, where it is prepared to renew burned-out incandescent lamps of any voltage or base on short notice. The treasurer's office is at 220 Devonshire street, Boston.

The W. P. Freeman Electric company of 106 Liberty street, New York, has been showing a large increase in its business during the last few months. This concern makes a specialty of expert work in the electrical trade, in perfecting models of all kinds, which is under the

direct supervision of Dr. W. P. Freeman, who is widely known.

The Detroit Electric Heating company of 132 Shelby street, Detroit, Mich., makes a specialty of multitubular electric heaters, which it announces as "the latest and best" for warming small rooms, motor cars, cabins, staterooms, show windows, sleeping rooms, bath rooms, offices, etc. The company also makes car and wall heaters, and will gladly furnish estimates.

Milling machines, as made by the Cincinnati Milling Machine company, are described in a comprehensive catalogue just issued. For many years this concern has made the manufacture of milling machines an exclusive specialty, with the constant purpose to have these machines excel in their particular line. The many novel features embodied in their design, for ease and convenience of manipulation, and great strength throughout, are claimed to insure the greatest productive capacity.

The Phillips Insulated Wire company of Pawtucket, R. I., is sending to its friends a very attractive calendar for the new year. It is gotten up in handsome colors and with the company's usual good taste. Prominently, of course, is seen the well-known "O. K." trademark, which is such a household word in the electrical business. The company has noted its various agencies on each month of the calendar, which makes it convenient for customers to communicate with the nearest office. These calendars will be sent upon application.

The Electric Appliance company looks back on the Christmas season just passed as a particularly satisfactory one, not only for the reason that it represents the beginning of the sixth business year of this concern, but also on account of the very satisfactory way in which the orders came in during the month of December, at which time, the company reports, business seemed to take quite a jump.

Having removed to more spacious quarters, and put in new machinery, E. H. Grubbé & Co., refiners and assayers of 2836 Church court, Chicago, are now better able than ever before to do justice to a large and constantly increasing business. They solicit sales of burnt-out incandescent lamp bases and will buy all kinds of bases, the Bernstein and all other common varieties, paying the highest cash prices.

Rainbow packing is a commodity which has strongly identified itself with the electrical business during the last year, and the large increase shown in the call for it has proved its utility. The Peerless Rubber Manufacturing company of New York reports that the business in this department has increased to such an extent that it has been obliged to enlarge its facilities at the factory to meet the increased demand. The company states that it is now in a position to fill all orders immediately upon receipt, of any amount and size, for the Rainbow packing.

Word has been received from President I. J. Kusel, of the Missouri Telephone Manufacturing company of St. Louis, to the effect that his men were obliged to work in the factory on New Year's day, so pressing is the work. This speaks pretty well for the trade of this enterprising institution. The Missouri Telephone Manufacturing company has certainly brought itself steadily to the front, and from the start its growth has been a healthy one. Messrs. French & Kusel, respectively the electrician and active manager of the company, deserve great credit for their energetic and successful work.

The interest in silex, which was aroused several months ago upon the announcements which were sent out as to its insulating qualities, continues unabated. The office of the Silex Insulation company at 39 Cortlandt street, New York, is constantly visited by large numbers of people who are investigating its merits, and some of the best informed men in the trade have spoken in the highest terms of the proofs which have been given in its favor. This concern is now completing several installations which will be open to public inspection soon, and for interior conduit the system of silex insulation seems to be particularly desirable.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued December 29, 1896.

573,859. Automatic Telephone Exchange System. Romaine Calleader, Brantford, Canada. Application filed March 19, 1896.

An automatic telephone exchange system comprising individual switches, each switch normally under the control of its individual subscriber; means for giving an independent progressive motion to a switch on the reception of a preliminary impulse from the subscriber normally controlling it, and additional means for causing the switches in their progressions to be brought into operative relation with the instrumentalities for interconnecting them.

573,874. Drum for Electric Controllers. Samuel Harris, Johnstown, Pa. Application filed October 6, 1896.

In a drum for electric controllers the use of pins extending upwardly and downwardly from the contact rings of the drum, and recesses on the top and on the bottom of the insulating disks of the drum, the recesses being adapted to receive the pins.

573,884. Automatic Telephone Exchange. Alexander E. Keith, Chicago, Ill. Application filed September 16, 1893.

Release mechanism at the central station is operated by a current of electricity which is controlled by a means which is initially started in operation by the gravity of the telephone receiver, this means comprising two compartments, with communicating passages between them, the ends of two wires insulated from each other, and both entering one of the compartments, the wires placed in electrical communication with each other and connecting the battery with the release magnet through the action of mercury or some other electric conductor.

573,903. Fire Alarm. John A. McGahy, New York, N. Y. Application filed April 30, 1896.

The combination with an electric circuit, of means for closing the same from an elevation of temperature, and a battery for supplying the current, of an electro-magnet, the armature having a counterweight and a notch or shoulder, a bar having a tag and slot, a contact-piece, a wire connecting the contact-piece with one pole of the battery, a bell or audible signaling device and wires, the one extended from the bar and the other from the battery, and both to the audible signal.

573,905. Electric Locomotive. James F. McLaughlin, Philadelphia, Pa. Application filed March 21, 1890.

The motor has worms of different pitch, one at each end of the armature shaft, the worm-gears meshing with the worms and loosely mounted on the drive-wheel axles, and connected and oppositely operating clutches also mounted on the axles for coupling the worm-gears thereto.

573,911. Electric Arc Lamp. Levi H. Page, Chicago, Ill. Application filed March 12, 1896.

The globe has an air-tight closed lower end, and carries within such end a support for the lower carbon, the globe being provided at its open upper end with an interior shoulder, a mica shield disk removably arranged within the upper end of the globe on the shoulder, and provided with a central carbon hole and a series of ventilating openings, and a grooved cap-ring fitting over the upper edge of the globe, and provided with an in-turned retaining flange projecting over the upper edge of the disk.

573,924. Fire Alarm System. Albert C. Rogers, Plainfield, N. J. Application filed January 25, 1896.

A normally closed main-line circuit, including therein in series the fire-boxes, a station gong and a general gong or whistle, a normally open annunciator circuit including the main line, and an annunciator having a wire connection with each box and with the main line, and a circuit breaker arranged in each box and adapted to alternately break the main-line circuit and close the annunciator circuit.

573,929. Incandescent Lamp Fitting. Alfred Swan, New York, N. Y. Application filed March 28, 1896.

The combination with the neck of an incandescent lamp provided with a bead of glass at or near the end thereof, of a metallic collar placed thereon entirely behind the head of glass, and collar forming one of the lamp terminals.

573,932. Electro-pneumatic Block Signal System. Adelbert H. Thorp, Toledo, Ohio. Application filed April 10, 1896.

The second claim reads: In a block-signal system, a semaphore arm, a vertically movable rod lowered thereby, a catch for holding the same in a raised position, a track circuit normally closed but opened by a moving train, a semaphore-releasing circuit controlled by the track circuit, having circuit breakers controlled by the movement of the semaphore arm, and a pneumatic means for resetting the semaphore arm, each primarily operated by the track circuit and then operated by the movement of the semaphore arm to either release the catch and allow the semaphore arm to rise by gravitation or to open a valve in the pneumatic means to pneumatically set the semaphore arm to indicate clear signals.

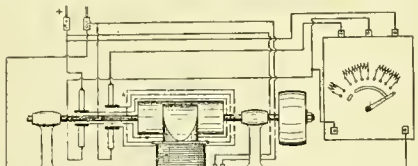
573,944. Fire Alarm. Asa H. West, Lynchburg, Va. Application filed March 30, 1896.

In an automatic fire-alarm, the combination of a drop-lever having one of its ends bifurcated, a hinge plate provided with a stud pivoted to the bifurcated end of the drop-lever, an arm secured to the drop-lever, a circuit closer disposed below the hinge-plate and adapted to be operated by the drop-lever, a combustible cord or other fusible connection secured to the drop-lever and provided with branches, a series of eyes for receiving the fusible connection, and a fusible ball mounted on one of the eyes, whereby the drop-lever is normally held out of contact with the circuit closer.

573,948. Circuit Closer for Electrical Alarm Circuits. John C. Wollin, Williamsport, Pa. Application filed September 11, 1896.

This device comprises a fixedly positioned oscillatory support included in an electrical alarm circuit, an oscillatory contact rod adjustably fitted to the oscillatory support, a balance weight adjustably mounted on the rod at one side of its support, a shallow concavo-convex metallic impact cup fitted to one end of the contact rod, and adapted to be arranged over the point of escape for compressed air, steam, or other gas, and a fixedly positioned contact post included in the same circuit with the oscillatory support and arranged in the path of the contact rod.

573,962. Searchlight. Arthur E. Colgate, New York, N. Y. Application filed December 24, 1895.



NO. 573,979.

One of the carbons is held stationary when the arc is formed, and the other is movable. Features are: A feed-screw for the movable carbon, a clutch for the feed-screw, a shunt magnet for operating the feed-screw through the clutch, a circuit controller in the shunt circuit operated by the armature of the shunt magnet to open the circuit, and means for operating the controllers to close the circuit independently of the movement of the armature.

573,966. Insulator Hanger. Robert Duncan, San Francisco, Cal. Application filed December 31, 1895.

A hanger for electric insulators, consisting of a flat piece of metal bent or cast to removably and loosely fit over the flange of a metal beam, the hanger being retained on the beam by the horizontal tension of the wire.

573,979. Apparatus for Varying Speed of Electromotors. Ludwig Imhoff, Berlin, Germany. Application filed July 3, 1896.

The combination with an electric motor, having a plurality of separate armature windings preferably wound on one core, separate commutators connected to the respective armature windings, a switch for placing one or more of the armature windings in circuit with the source of electricity, and resistances for insertion in series with the motor at every transition from an armature winding containing a lower number of turns to an armature winding containing a higher number of turns.

573,980. Railway Rail Bond. Byron Jennings, San Jose, Cal. Application filed April 17, 1896.

A railway rail bond consisting of side plates bolted to the webs of the meeting rails, having flanges extending around and beneath the rail flanges, a base-plate channeled to be engaged by the flanges of the side plates, whereby it is held in close contact with the bottom of the rails, the plate having a depressed chamber beneath the meeting ends of the rails, a curved spring fitting the chamber, and which, when straightened, forms with the plate a solid support for the rail ends, and a copper surface plate fitted upon it extending across the joint, so as to make a continuous electrical connection through the rails.

574,005. Telephone Circuit. Charles E. Scribner, Chicago, Ill. Application filed April 20, 1895.

The fourth claim reads: The combination with a metallic circuit telephone line, of a receiving telephone at each terminal station thereof having a magnet coil in each line conductor, the magnet coils being arranged to neutralize each other when traversed by currents of the same direction in the line conductors, a supply circuit comprising the two line conductors grouped in parallel and a single return conductor, an induction coil at each station having its secondary helix in the line circuit, and having its primary helix divided into two portions in different parallel branches of the return circuit, and a transmitting telephone in one of the branches, the normal resistances of the branches being approximately equal.

574,006. Test System for Multiple Switchboards. Charles E. Scribner, Chicago, Ill. Application filed July 5, 1895.

In a multiple switchboard, spring-jacks connected in multiple with the line, a test contact in each jack, all the test contacts being electrically connected together, means for making connection with the line and simultaneously altering the electrical condition of the test contacts thereof, a testing plug adapted to be applied to the test contacts and a telephone in circuit therewith adapted to indicate the altered electrical condition, a connecting plug and a visible signal in circuit with the plug adapted to indicate the altered condition.

574,035. Method of and Means for Regulating Alternating Current Generators. Benjamin G. Lamme, Pittsburg, Pa. Application filed March 11, 1896.

This method of varying the electromotive force of an alternating current generator as its load varies consists in varying the slip of an alternating current motor driven by current derived from the generator, and producing a field magnet exciting or regulating current by the power derived from the motor.

574,038. Electro-plating Apparatus. Richard J. Marks, Hartford, Conn. Application filed October 12, 1896.

A holder for electrolytic work, comprising two elongated parallel conductive sections, a non-conductive stop interposed between adjacent edges and insulating the conductive sections, and a conducting hanger in connection with each section.

574,045. Electric Arc Lamp. Charles E. Scribner, Chicago, Ill. Application filed May 9, 1893.

The third claim is given: The combination with two pairs of carbons included in an electric circuit, of regulating mechanism adapted when actuated to effect the separation or approach of the members of each pair of carbons, an oscillating magnet in the said circuit or a branch thereof, a source of magnetic field of constant direction about the said magnet, and means connected with the magnet to be actuated thereby adapted to bring about the operation of one pair or the other of the carbons according to the movement of the said magnet with relation to the magnetic field wherein it is situated, whereby either pair of carbons may be brought into operation by suitably directing the current through the magnet.

574,046. Toll Box for Telephones. Charles E. Scribner, Chicago, Ill. Application filed May 14, 1896.

The combination at a telephone toll-station, of the toll-box or coin receptacle, an electrically controlled locking device for the toll-box connected with the telephone line, a spring-jack or socket for the line at a central station, and means for connecting therewith a source of electric current to release the locking mechanism.

574,065. Bulb for X-rays. John von der Kammer, Chicago, Ill. Application filed March 17, 1896.

A bulb for the production of X-rays comprising a spherical body, having on one side cavities for the electrodes, and electrodes in the cavities for the anode and cathode respectively, the electrodes being so disposed that their rays shall have a common focal point.

574,101. Insulator. Charles B. Martin, Schenectady, N. Y. Application filed September 28, 1896.

This insulator seems especially adapted for the conductor rails in third-rail systems. Malleable iron rail clamps are adapted to be slid upon the rail from the ends; lugs on the clamp are provided for gripping the rails and preventing any angular movement of the clamp. A metal base, a body of insulating material mounted on the base, and means on the insulator for securing it to the rail clamp by an angular movement are also features of the invention.

574,117. Electric Arc Lamp. Henry A. Seymour, Washington, D. C. Application filed June 30, 1896.

The combination with the carbon holder and lower and non-feeding carbon of an arc-inclosing globe and feeding carbon suspended from the carbon holder by a universal joint, this globe being provided with a cover on its lower end, having an opening in it through which the lower carbon passes.

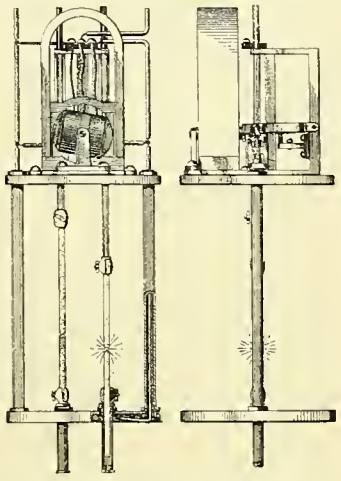
574,118. Electric Arc Lamp. Henry A. Seymour, Washington, D. C. Application filed July 11, 1896.

In an arc lamp the combination with its feeding carbon, of means for slowly and gradually separating the feeding carbon from its mate and slowly drawing the arc to any desired length, and means for slightly checking the movement of the feeding carbon while the lamp is burning a normal arc, of means for automatically relieving the regulating mechanism from the action of such arc-drawing retarding mechanism, and means for automatically adjusting the clutch-tripping floor or device to insure the maintenance of a normal arc.

574,119. Electric Arc Lamp. Henry A. Seymour, Washington, D. C. Application filed July 18, 1896

An arc-inclosing globe provided with a cover which is mounted upon and supported by the carbon holder.

574,120. Electric Car Brake. Elmer A Sperry, Cleveland, Ohio. Application filed June 26, 1896.



NO. 574,045.

Brake magnets are actuated by a storage battery; circuit connections for supplying the magnets and the battery with current from the motor, means for automatically cutting out the battery when the armature current falls below a predetermined potential, and means for connecting the battery with the brake magnets are also provided.

574,123. Electric Arc Lamp. Elihu Thomson, Swampscott, Mass. Application filed August 21, 1896.

A pair of solenoids for regulating the lamp, and cores connected by a yoke co-operating with the solenoids, in combination with a clutch comprising a pair of levers connected with the cores by toggle levers, and having portions engaging with the carbon rod, the whole arranged to increase the grip of the clutch as the cores are drawn upward.

574,160. Means for Reheating Exhaust Steam. Oscar D. McClellan and Wilkinson T. Girling, Philadelphia, Pa. Application filed July 1, 1896.

The combination with a steam engine of a heating chamber, means whereby the exhaust steam from the engine is delivered to the chamber, electrical heating devices in the chamber, means for supplying an electric current thereto at predetermined intervals, and means whereby the reheated steam in the chamber is returned to the engine.

574,171. Electric Railway. John A. Roche, Chicago, Ill. Application filed April 13, 1895.

With a slotted conduit and a supply conductor of movably supported, insulated conductor sections located in the upper part of the conduit at one side of the slot therein are combined stationary and movable contact-pieces located near the top of the conduit at the side of the conduit slot opposite the conductor sections, and means for actuating the movable contact-pieces from the conductor sections, embracing arms which extend across the conduit beneath the slot.

574,203. Electric Branding Stamp. James M. Kirker, McGonigale Miller and James A. Williams, Louisville, Ky. Application filed March 16, 1896.

An electric branding stamp consisting of a plate, an annular flange located on the plate, a second plate composed of non-heat conducting material secured to the under side of the first plate, an electric conductor secured to the under side of the non-heat-conducting plate, the electric conductor being connected with an electric generator, a metallic plate located within the annular flange of the first plate, screws passing through the annular flange and securing the metallic plate in position, the upper surface of the last plate coming in contact or close proximity with the electric conductor, the under side of the last plate being provided with suitable characters.

574,205. Race Starting Machine. William Maxwell, St. Louis, Mo. Application filed June 29, 1896.

A suitable barrier movably suspended across a race-track, and electrically operated mechanism for holding and releasing the barrier, which mechanism consists of electro-magnets, armatures operated by the magnets, pivotally mounted jaws adjacent to the magnets, toggle-joints operating the free ends of the posts supporting the jaws, trip mechanisms for holding and releasing the toggle-joints and in positions to be operated by the armatures, and hooks attached to the barriers and designed to engage the jaws.

574,215. Electro-motor Magnet. Charles Partington, Newport, Ky. Application filed March 6, 1896.

An electro-motor magnet having the wire terminals of its separate limbs arranged opposite each other is combined with a switch adapted to be moved from one set of terminals to the other for changing the current through the terminals of the magnet from parallel circuits to serial circuits, and vice versa, an armature and a cam controlled from the armature to actuate the switch.

574,217. Voltage Regulator for Dynamos. Thomas M. Pusey, Kennet, Pa. Application filed May 22, 1896.

A voltage regulator for dynamos, comprising a main circuit, a rheostat in a shunt circuit of the dynamo, a helix also comprised in a shunt circuit, a balanced beam operated by the helix and serving as a contact closer, a rheostat operating motor, an electrically operated brake for the armature of the motor, and connections between the armature and the rheostat for operating the latter.

574,221. Telephone Exchange System. Charles E. Scribner, Chicago, Ill. Application filed June 6, 1894.

The first claim: The combination with a telephone line normally open at a sub-station, provided with a switch adapted to close a circuit through a telephone there, of an annunciator together with a source of current in the line circuit at a central station, a connecting plug for making connection with the line, a magnet-coil separate from the main coil on the said annunciator adapted to reset and retain the indicator thereof, the normally open local circuit connections distinct from the line circuit including the said magnet-coil adapted to be closed when the said connecting plug is inserted into a line spring-jack, a clearing-out annunciator adapted to display its indicator upon the cessation of current through it, and circuit connections completed with the said line when connection is made therewith including said clearing-out annunciator.

574,222. Selective Signal System. Charles E. Scribner, Chicago, Ill. Application filed January 8, 1895.

In a call device the combination with an electro-magnet and an armature polarized by the electro-magnet, the magnet having two helices, of a second motor electro-magnet adapted to vibrate the armature when excited by an alternating current, an electric circuit including the motor electro-magnet and divided into branches including the different helices of the polarizing magnet, and means for transmitting alternate pulsations of current through the branches.

574,223. Selective Signal. Charles E. Scribner, Chicago, Ill. Application filed August 23, 1895.

Features enumerated are: A ratchet-wheel of a pawl, means for imparting to the pawl successively a longitudinal movement radially to the wheel and then a transverse movement, a detent, and a link connecting the detent and pawl adapted to cause the detent to be disengaged from the ratchet-wheel during the transverse movement of the pawl.

574,224. Spring-jack for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed July 5, 1894; renewed July 13, 1896.

The combination with a plate having a tubular channel, a transverse saw cut, and an oblique duct leading from the tubular channel to the saw cut, of a thimble inserted in the tubular channel, the extension thereof passing through the oblique duct into the saw cut and twisted at its rear extremity to prevent its withdrawal from the saw cut.

574,225. Signaling Apparatus for Telephone Lines. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Application filed August 17, 1895.

A source of continuous current permanently connected in the line circuit at a central station, a transformer at the sub-station having one of its helices in the line circuit, a polarized bell at the sub-station in circuit with the other helix of the transformer, a source of alternating current at the central station, and means for connecting it with the telephone line to operate the signal bell.

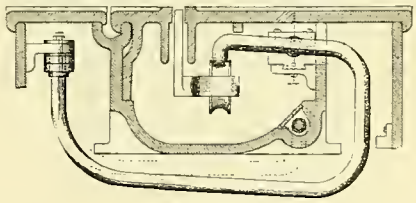
574,231. Current Controller or Rheostat. Ernest E. Werner, Dallas, Tex. Application filed June 22, 1896.

A revoluble cylinder having upon its periphery a substance adapted to resist an electrical current, composed of black-lead and an alcoholic solution of shellac, with a brush adapted to travel laterally along the cylinder and making contact with the resistance and means for revolving the cylinder and imparting motion to the brush.

574,245. Telephone Switch Box. Wallace A. Houts, Parker, S. D., and Lars G. Nilson, Sioux City, Iowa. Application filed August 25, 1896.

An automatic call for telephones, comprising a casing, an escapement wheel mounted therein and adapted to make and break an electric circuit, a locking device for the escapement wheel, a second wheel mounted to rotate relatively to the first-named wheel and carrying a disk having telephone call-numbers thereon, a spring connection between the wheels, a locking device for the last-named wheel, and means for automatically releasing the locking device through the weight of the telephone receiver.

574,255. Telephone Exchange Apparatus. Frank R. McBerty, Downer's Grove, Ill. Application filed May 25, 1896.



NO. 574,171.

In combination, two metallic-circuit telephone lines, a ground branch at the different sub-stations from like line conductors, and a signal bell in each ground branch, a spring-jack for each line in a switchboard, a double-connecting plug in each spring-jack, unlike contact pieces of the plugs being connected together, a grounded generator of calling current, and means for applying the free pole of the generator to either of the conductors of the plug circuit.

574,278. Motor-generator. Charles E. Scribner, Chicago, Ill. Application filed June 1, 1889.

The first claim: A motor having a single closed-coil armature and a pair of adjustable brushes in a supply current and a second pair of brushes in a working circuit in combination with a regulator for moving said adjustable brushes responsively to variations in the potential between the different sides of said working circuit to maintain said potential practically constant.

574,279. Signaling Circuit for Telephone Trunk Lines. Charles E. Scribner, Chicago, Ill. Application filed May 14, 1896.

The combination with a circuit having a source of current in it, of two groups of polarization cells interposed in a conductor of the circuit, and a closed circuit including the conductor intermediate of the polarization cells, together with a source of current and a signaling instrument.

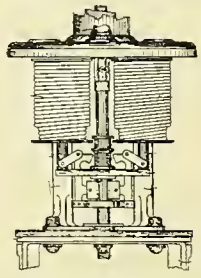
574,280. Automatic Signaling Device for Telephone Exchanges. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Application filed November 27, 1894.

A bell at a telephone sub-station, a source of current in circuit therewith, and mechanism adapted to periodically break and close the circuit through the bell a limited number of times while the magnet remains continuously excited, are described.

574,281. Plug for Telephone Switchboards. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill. Application filed May 31, 1894; renewed June 19, 1896.

A tube forming or carrying one contact portion of a connecting plug is combined with a second contact portion surrounding and secured upon a projecting portion of the tube, and a wire extends from the second contact portion through the tube to the interior of the plug.

574,301. Electric Lamp Base. Waldo C. Bryant, Bridgeport, Conn Application filed October 31, 1896.



NO. 574,123.

A Thomson-Houston incandescent electric lamp base of porcelain or other such material having a reduced lower end for the reception of a flanged ring terminal and passages extending from the interior of the hollow base to the reduced end to form lateral openings in the latter, into which the ring terminal can be indented.

574,320. Electric Water-wheel Governor. Arthur Giesler, Dayton, Ohio. Application filed April 20, 1896.

A machine for controlling the movement of water-wheel gates, having a governor positively driven by the water wheel, two electric circuits the terminals of which are controlled by the governor, mechanism operated by the circuits for actuating gate-operating mechanism in both directions, and means operated by the governor for quickly breaking the circuits to prevent excessive movement of the gate and slowly bring back the parts into position for the next operation.

574,322. Electrode for Secondary Voltaic Batteries. George A. Grindle, Prestwick, England. Application filed October 13, 1896.

For filling the holes of an electrode plate for a secondary voltaic battery, plugs, each consisting of a rolled up strip of lead, having on its one side transverse ridges and furrows, all the ridges being connected by a central longitudinal ridge.

574,327. Electrical Annunciator. Robert L. Hunter and Henry B. Higgins, Minneapolis, Minn. Application filed November 19, 1895.

The combination with a train of gears, an indicating mechanism, a signal bell, a main magnet for tripping a train of gears, and a series of push-buttons for closing the circuit through the magnet to release the train, of a relay magnet in a divided circuit with the train of gears and battery, and having its armature and a make-and-break device operative by the armature in circuit with the main magnet.

574,333. Mechanism for Locating and Determining Defects in Rail Bonding. Pierre O. Keilboltz, Baltimore, Md. Application filed February 29, 1896.

The device comprises a series of contacts connected in pairs through the medium of potential indicating or recording instruments and electrical conductors, the pairs being adapted to conduct an electric current in parallel, each pair of contacts being arranged to make sliding or rubbing contact at simultaneously corresponding points on a separate conductor.

574,341. Apparatus for Generating Ozone. Marshall Pridham, Philadelphia, Pa. Original application filed September 12, 1896; divided and this application filed October 15, 1896.

The combination of separated casings, one being dielectric, each provided with a thin sprinkled coating of powdered or granular conducting material, suitable for producing an electrical brush discharge, the dielectric being between the coatings, means for causing a flow of oxygen through the space between the casings and means for conveying an electric current to one and away from the other of the coatings.

574,345. Trolley. Nelson D. Stanley and John S. Reynolds, Essex, Vt. Application filed April 16, 1896.

The combination with the trolley pole having a fork in which is mounted the main wheel; the pole having an aperture through it at the base of the fork, of a vertically swinging yoke depending from the axis of the main wheel and having a rod extending upwardly through the aperture in which it slides, a spiral spring on the rod, and bearing against the pole and a shoulder on the rod to press the yoke rearwardly and upwardly, an arm projecting rearwardly and upwardly from the bottom of the yoke and an auxiliary trolley-wheel carried by the arm.

574,364. Telegraph Pole. Cyrus A. Peterson, Stratton, Neb. Application filed November 11, 1891.

The pole consists of an angularly bent metal sheet having a series of holes in the angle thereof, and an angular supporting plate riveted thereto, in combination with insulator-carrying bars having converging grooves therein to receive the edges of the pole, and bolts passing through the bars and through the holes.

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Electrical Equipment of the Union Loop, Chicago.

There is perhaps no electrical undertaking now under way in Chicago of greater magnitude than the equipment of the Union Loop elevated railroad. This structure is building by the Loop Construction company for the Union Elevated Railroad company, which was organized to furnish greatly needed terminal facilities in the down-town business district to the four elevated railroad companies of Chicago. Hitherto the elevated roads have been greatly hampered by the fact that they were allowed only to touch the confines of the great retail shopping district at their respective termini, and did not penetrate within it. Thus they were at a considerable disadvantage in competing with the surface lines, as the latter fairly form a gridiron network of tracks in the down-town streets. To supply this need the Union Loop was projected some time ago, and, after much discussion and negotiation with the city authorities and the owners of abutting property, the structure is now nearly completed.

This loop will provide a common route for all the elevated railroad companies around the central business district, the trains of each going upon it at or near the present terminus, making the circuit and leaving the loop at the place of arrival. By this means each of what may be termed the trunk-line companies will greatly extend its terminal facilities, tapping a busy portion of the city not now reached, and it will also be possible to arrange a very advantageous interchange of passengers, so that travel from one side of the city to the other will be greatly facilitated. A resident of the South Side, for instance, will be enabled to journey far on the North Side or West Side without descending to the ground or taking a long walk to make connections. This is really a great step in advance in the improvement of rapid transit in Chicago.

The Union Loop is a very substantial double-track elevated structure, about 2½ miles long, forming on the map a rectangular figure, with sides on Fifth avenue, Lake street, Wabash avenue and Van Buren street. It is or will be connected with the lines of the Metropolitan West Side Elevated Railroad company, the Lake Street Elevated Railroad company, the Northwestern Elevated Railroad company and the Chicago South Side Rapid Transit Railroad company. Of these, the first two named are now electrically operated, the Northwestern is under construction as an electric line, and the "Alley L," as the last named is generally called, will make use of electric power within two years, although now employing steam locomotives. The Union Loop, it should be stated, is owned and operated by an entirely distinct company which will lease the power and right of way to the four companies actually using the structure. As all the contributing companies use or are soon to use electric power, it is evident that the loop plant must ultimately be equal to the demands of all four roads at the busiest hours. It is thought that the maximum traffic will not exceed 45 trains on the loop at one time. This would require something like nine or ten thousand horse power, but as this is a maximum estimate of the business of the future, certain not to be reached at first, and perhaps not at all under conditions of actual practice, the power house will have an engine capacity of 7,500 horse power when put in operation, although designed to be readily increased to 10,000.

The location of the power house is on Market street at the head of Congress street. The site is of irregular shape, as shown in the general plan (Fig. 5, p. 32) and runs back to the Chicago River. Across the river, in neighborly proximity, is the large Harrison street station of the Chicago Edison company. Work on the power house has been under way for some time, and the foundations are now all in. In planning and constructing the foundations great care was exercised, as the character of the soil made it necessary to resort to piling. The piles are close together and deep driven. One of them pierced the tunnel laid under the river to hold the feeder cables of the Chicago Edison company. Fortunately the wires themselves were not injured, and the damage was repaired without great inconvenience.

In one respect this power house is unique in the West. It is on the "double-deck" plan, having engines and generators on the ground floor, but the boilers above them.

FIG. 1. ELECTRICAL EQUIPMENT OF THE UNION LOOP, CHICAGO.—FEEDERS AND FEEDER BOX AT MADISON STREET DEPOT.

in the second story. It is believed to be the only railway power station west of Philadelphia thus constructed. The exigencies of space made this arrangement advisable. The plan of the engine room, on the first floor (Fig. 5), and the longitudinal section (Fig. 4) show how the idea is carried out. The front elevation of the building, of Bedford stone and pressed brick, is shown in Fig. 3, on page 31. This street frontage is 141 feet and there is a river front of 62 feet. The building is 164 feet deep and the walls are 98 feet high. The stack will be of brick, octagonal in shape and 240 feet in height. It will furnish draught to the furnaces of 16 Babcock & Wilcox boilers of 400 horse power each, supplied with Acme mechanical stokers. There will be a complete equipment of coal and ash-handling machinery, and ample coal storage is provided.

Three engines are to be installed at present, and room is left for a fourth of the same size, as shown in Fig. 5. Each engine has a maximum capacity of 2,500 horse power and is directly coupled to a standard railway generator of 1,500 kilowatts capacity, built by the Siemens & Halske company. The engines are cross-compound and condensing and are from the original Corliss works in Providence. They are designed for 150 pounds steam pressure and turn, with the revolving parts of the generator, at 75 revolutions per minute. The generators have 16 poles each and supply current at 550 volts. Wheeler condensers and Blake pumps are included in the steam equipment. Two large hand-power traveling cranes will be installed, in addition to smaller post cranes. The switchboard will be of slate, and from it will be controlled four power circuits for the loop structure, one lighting circuit for the loop and six feeder circuits for surface electric roads in the down-town district.

A subway leads from the switchboard through Market street to Van Buren to connect with the elevated structure. The cables will be drawn through this and carried up on to the loop on four of the supporting columns 50 feet apart. The manner of supplying the current to the motors of the patronizing companies differs slightly in detail from the method in use on the Metropolitan and Lake Street roads. The steel contact rail, commonly known as the "third rail," is inside and slightly above each of the tracks, and the general arrangement is clearly shown in the sectional drawing, Fig. 2. The "third rail" is of steel and weighs 45 pounds to the yard. The copper feeders are placed in a wooden feeder box between the tracks, and the top of this box forms a plank walk for the use of employes. In the photographic reproduction (Fig. 1) one section of this covering is removed, and the massive bare copper cables—of 1,300,000 circular mils area—can be seen beneath. This picture was taken in the depot at Wabash avenue and Madison street, and it also shows the manner of carrying the cables through the central girder plates at the depots. At these points the feeders are insulated and lead-covered and carried, on each side of the upright portion of the girder, through bushings in the steel plates. The construction is clearly shown in the photograph and drawings, Figs. 1 and 2. The wooden feeder box also forms one side of the upright guards for the contact rail, as shown. The supports for the great cables are of clay, and, as represented in Fig. 2, space is provided for eight. The insulated cable shown in the photograph (Fig. 1) is for the lighting circuit. The fact that but two power feeders are shown in this picture is caused by the circumstance that the depot illustrated is nearly opposite the power house, where naturally the least amount of copper would be in sight. The demand for current cannot be accurately forecast, and if more feeders are needed they can be placed in position without great difficulty. Each track is wired on a separate feeder system, so that the two are quite independent, and a break-down on one will not affect the other. The bare copper was supplied by the American Electrical Works of Providence, while the insulated cables came from the General Electric company.

At present the Lake Street company is using the loop as far south as Adams street on Wabash avenue, and the feeder system, for the initial operation of the road at least, is completed on the latter street. Current is temporarily supplied from the Hawthorne avenue station of the North Chicago Street Railroad company. A connection with this station will always be maintained by a special switchboard at the interlocking tower at Lake street and Fifth avenue. Thus, in case of an emergency at the loop power house, as much as 2,000 horse power can be furnished to the loop from the North Side station if needed. It will also be possible, by this connection, to shut down the whole loop station at night.

It is hoped that electrically operated trains will make the circuit of the entire loop by June 1st. There will be 11 or 12 passenger stations on the structure and trains will run between them at a maximum speed of 15 miles an hour, making an average rate of about 10 miles an hour, thus taking not more than 15 minutes to go around the loop. The engineers in charge of the electrical equipment are James R. Chapman and S. Potis, Jr. Mr. Potis designed the mechanical equipment of the power house and Mr. Chapman supervises the electrical construction.

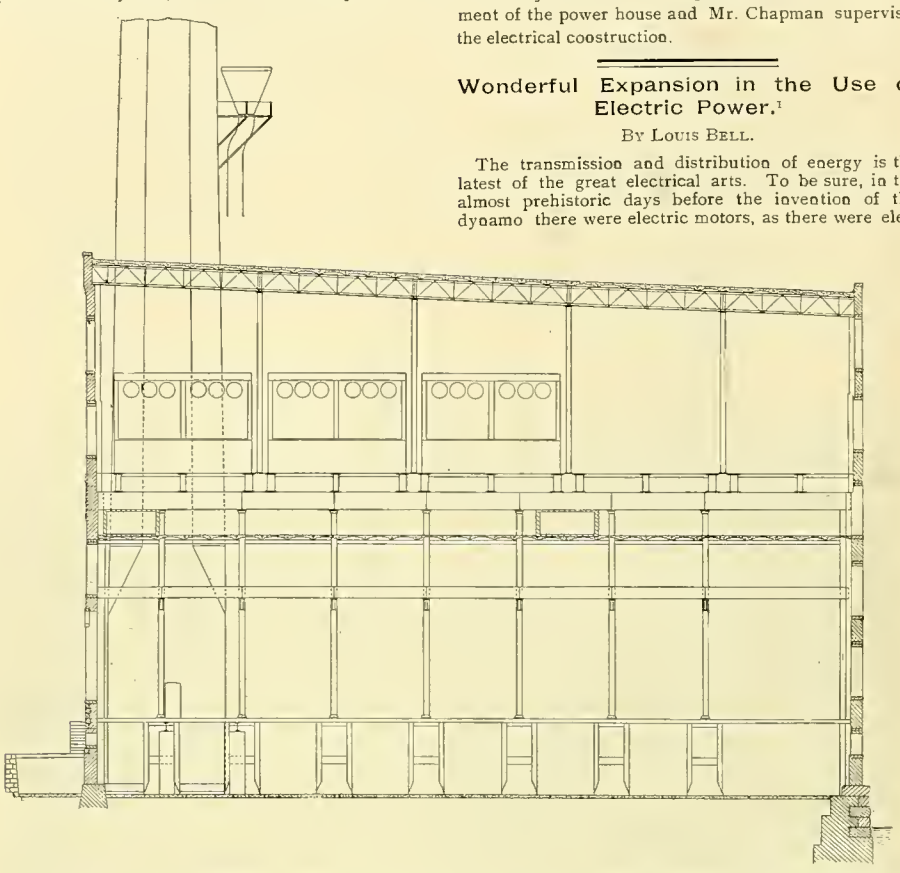

FIG. 4. ELECTRICAL EQUIPMENT OF THE UNION LOOP, CHICAGO.—LONGITUDINAL SECTION OF POWER HOUSE.

Wonderful Expansion in the Use of Electric Power.[1]

By Louis Bell.

The transmission and distribution of energy is the latest of the great electrical arts. To be sure, in the almost prehistoric days before the invention of the dynamo there were electric motors, as there were electric locomotives and electric lights, electric heaters and electric boats; but the ingenuity of Henry, Jacobi, Davidson and Page led to no useful end. Their machines were relegated to the scrap-heap or the cabinet shelf by the same grim logic of economy that, in the fullness of time, has forced the modern motor into the front rank of industrial improvement.

When, just a quarter of a century ago, Gramme and Siemens gave the dynamo substantially its present form, every kind of electrical work received a sudden and powerful impetus. The subsequent half dozen years were crowded with developments. In 1873 the first motor of modern type was put into operation at the Vienna Exposition by Fontaine and Breguet, the motor working a little pump through a mile or so of cable. In the next few years motors were occasionally exhibited or put to temporary use, but it was not until the autumn of 1878 that experiments and demonstrations culminated in commercial operation.

The time was propitious; the growth of electro-plating

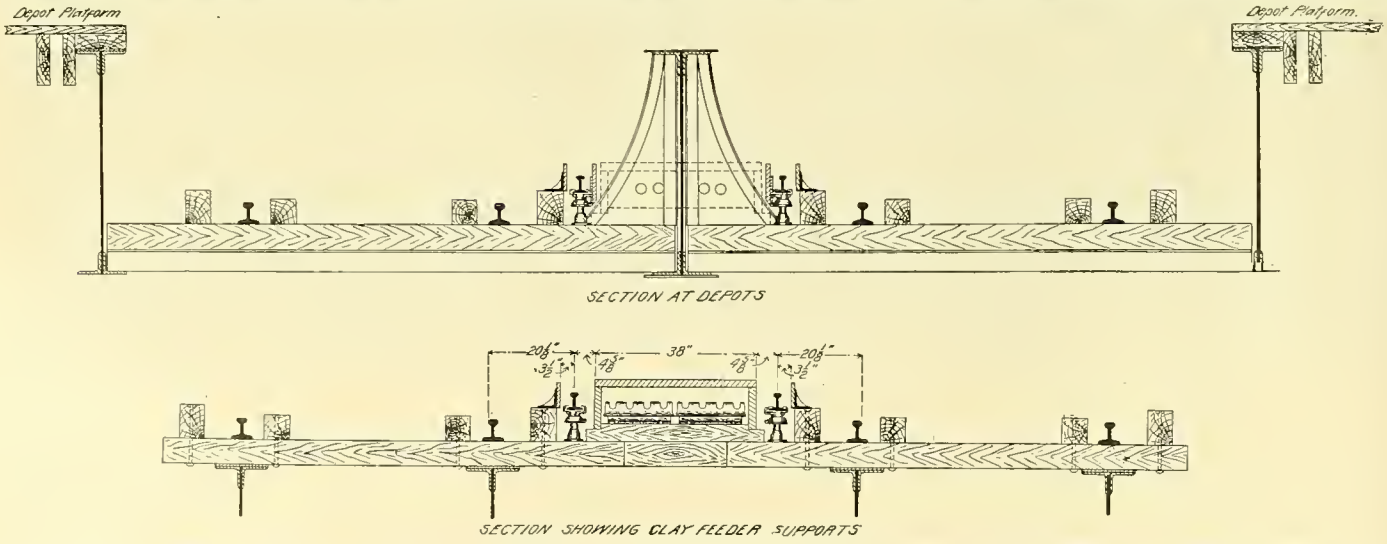

FIG. 2. ELECTRICAL EQUIPMENT OF THE UNION LOOP, CHICAGO.—CROSS-SECTION OF ELEVATED STRUCTURE, SHOWING FEEDER BOX AND CONTACT RAILS.

1. From the *Engineering Magazine* for January, 1897.

and electrotyping had given the dynamo builders encouragement and occupation; the arc lamp had outgrown the laboratory and the lecture room, and was becoming a practical illuminant. It was whispered, too, that if the experiments then in progress on incandescent lamps were successful on a commercial scale, the problem of general electric lighting was to be at last accounted as solved.

More than this, some convenient and economical means of transmitting and distributing mechanical power had long been badly needed, and men were ready to turn hopefully to the potent force that had already achieved so much. Power transmission by wire ropes and by compressed air had already been weighed in the uncompromising balance of experience, and had been found wanting—the former in flexibility, the latter in efficiency.

In the latter part of 1878 MM. Chrétien and Félix installed in the beet-sugar works at Sermaige the first commercial electric motor, operating a little hoist used in unloading the beets from the boats in which they were brought down the river. During the succeeding winter 4,000 tons of beets were thus unloaded, and the cost was found to be about 40 per cent. less than unloading by hand. The motor developed only two or three horse power, and received its energy from a similar generator about 20 rods away. From this beginning has sprung the prodigious growth of to-day.

The next summer the first electric railway was put into operation at the Berlin Exhibition—a single car, capable of carrying 15 or 20 passengers, and running over 50 rods of track. The transmission of energy to both stationary and moving motors was quickly taken up in this country. S. D. Field and Edison were pioneers in the work; in fact, the former was actively experimenting when the foreign work was made known; and presently scores of inventors were busy, with true Yankee push, in working out the manifold applications of electrical motive power.

At first the only available sources of current were the recently established arc light circuits. Upon these small motors began to appear soon after 1880, and with increasing frequency in the next succeeding years. Soon Edison lighting stations became available, and during 1882 and 1883 small motors began to go into service in connection with them. By the fall of 1884, when the Philadelphia Electrical Exhibition was in progress, the electric motor was firmly established as a machine commercially available, and its valuable properties were well understood. In fact, the electrical expositions of 1881 in Paris and 1882 in Munich had shown the capabilities of motor service, and at the latter had been shown the first experiment in long-distance power transmission—an experiment more daring and revolutionary even than the famous one at Lauffen-Frankfort nine years later.

This work was done by Marcel Deprez, and consisted in the transmission of power from Miesbach to Munich—37 miles, a distance longer than is spanned by any commercial plant in operation to-day. The line was of common telegraph wire, and the energy delivered was less than half a horse power, which was employed in driving a centrifugal pump. The voltage of the dynamo was about 1,350, and both generator and motor were specially wound Gramme machines. The station at Miesbach was the first power transmission plant in the world.

From 1884 the development of the motor, following up the growth of electric lighting, was increasingly rapid, and by the autumn of 1886 it was estimated that there were no less than 5,000 electric motors in use in the United States.

At the same period there were nine electric railways in operation, running 58 motor cars and aggregating 35½ miles of track. Many battery motors are included in this estimate, and the arc circuit was still an important source of power.

Thereafter the growth of the art was mainly in the direction of railway service, though the incandescent lighting stations soon began to take on motor service in considerable amounts.

In 1888 came the Tesla motor that has since played so important a part in the development of electric power, particularly in the past few years. As electric railways became more and more common, and engineers became more familiar with the construction and management of dynamos for fairly high voltages, motor work began to assume larger proportions and to reach out over greater distances. A few special motor circuits were installed at 220 and 500 volts, and a successful series motor distribution was started in San Francisco. But more experience was needed, and the time was not yet ripe, so that it was not until 1890 that power transmission as such began to gather headway. From 1890 dates the real period of industrial development.

By this time it was well ascertained that the electric motor was a thoroughly efficient and reliable machine, capable of being trusted with important work and fully able to compete with steam power under conditions that could often be realized. With power derived from ordinary central stations the motor was often far more economical in its operation than small steam engines with their attendant inconvenience and care; and it was obvious enough that no known means of transmitting power was so efficient or convenient for general purposes. Given a cheap source of power, the problem of its economical distribution was at last solved.

It was but natural that the mining regions of the far west, where coal was very expensive and water power plenty, should have been the scene of the first attempts at the electrical transmission of power. About the beginning of 1890 several transmission plants were put in operation, employing for the most part 500-volt railway generator and distributing power for mills, pumps and hoists. This was only a useful makeshift, and it was necessary to break away from ordinary voltages before power transmission could assume the industrial importance that is its due. The step was not an easy one, for high voltage was a dreadful bugaboo in 1890; but taken it was, both with continuous and with alternating currents, and early in the next season two notable plants went into operation—one at the Dalmatia Mine, California, transmitting 100 horse power at 1,800 volts 1½ miles; the other at Telluride, Col., delivering a similar amount of power 2½ miles away by means of a monophase alternating current at an effective pressure of 3,000 volts. A single synchronous motor was used, brought up to speed by a Tesla split-phase starting motor. At the Dalmatia Mine Brush continuous current machines were used, one at each end of the line.

The polyphase systems were as yet undeveloped, as shown by the use of monophase current instead; but the Tesla motor had already been in use, for in the summer of 1890 several Hercules mining machines had been equipped with them and put into regular service near Pittsburg. Then, in the summer of 1891, came the Frankfort Electrical Exhibition, which gave to electric power development the final impulse needed. Since then the transmission work in this country has been, with a few trivial exceptions, entirely polyphase. The next year saw much experimentation, much growth of ordinary motor service, but no power-transmission plants, save a small monophase synchronous one at Walla Walla, Wash., and another, closely similar to the Telluride plant, but of double the capacity, and working over a line 12½ miles long, at Bodie, Cal. A notable step was taken, however, in the establishment of a long-distance lighting plant, delivering energy from the generating plant in San Antonio Cañon to the towns of Pomona and San Bernardino, Cal., distant respectively 13¾ and 28¾ miles. An ordinary alternating generator was used, but the voltage was raised to 10,000 volts by a bank of 20 step-up transformers in series. It was the first commercial use of so high a pressure, and the extreme distance of transmission has been exceeded only within the past year.

The hard times were now drawing near, but the good work went along, and 1893 saw marked and substantial progress in the use of electric motive power. Not only was there steady increase in the installation of motors for every purpose, but the Columbian Exposition was rich in transmission apparatus, and before the end of the year three polyphase plants had gone into service, and—what was worthy of special note—the final steps had been taken to furnish the great Niagara plant with generators of American design and manufacture.

During the times of dire financial stress in 1893 and 1894, when many industries were completely prostrated, the electrical distribution of power grew as it had never grown before. Business men saw an opportunity of reducing operating expenses by securing cheap power, and grasped it. Aside from all the motors sold for factories and work-shops, contracts were made by the leading electrical companies for more than a score of polyphase transmission plants.

Notable among these were two great cotton mills at Columbia and Pelzer, S. C., equipped throughout with polyphase motors, for the most part applied directly to groups of machines, dispensing with the costly and complicated systems of belting and shafting heretofore used in such factories. The generating plant at Pelzer comprises three 750 kilowatt three-phase generators, directly coupled to turbines, delivering current at 3,300 volts to the mills 3½ miles away.

The next year saw increased activity and epoch-making work. In the early summer the Folsom-Sacramento three-phase plant went into operation, of 3,000 kilowatts capacity, furnishing all the power and light used in Sacramento, 23 miles away—the longest commercial transmission that had yet been installed. A little later the huge Niagara plant went into operation with its 5,000 horse power generators—an installation that for size and startling engineering features will stand unique for many a year to come.

In early autumn another sensational advance was scored in the starting of the enormous electric locomotives in the Baltimore & Ohio tunnel under the city of Baltimore. These colossal machines more than equaled in power the largest freight locomotives in existence, and their performance made the first great inroad into the realm of heavy railroad work—an incursion that will be pushed into the very citadel of steam. One of these locomotives, weighing 96 tons, has a drawbar pull of more than 60,000 pounds.

Motor plants of every kind have multiplied and the past year has seen greater progress than any which preceded it. Specially notable has been the transmission of power 35 miles into Fresno, Cal., at 11,000 volts—the longest commercial transmission yet accomplished anywhere; and very recently the long-delayed delivery of power from Niagara to Buffalo—1,000 horse power over a 27-mile line, with immense increase in immediate prospect.

And through all this growth one fact has been conspicuous. Wherever electric power has come, it has found a profitable market; the steam engine has gone out, and the electric motor has come in. There has been no failure, no long struggle with unprofitable conditions; the motor has done its work and pushed its competitors to the wall.

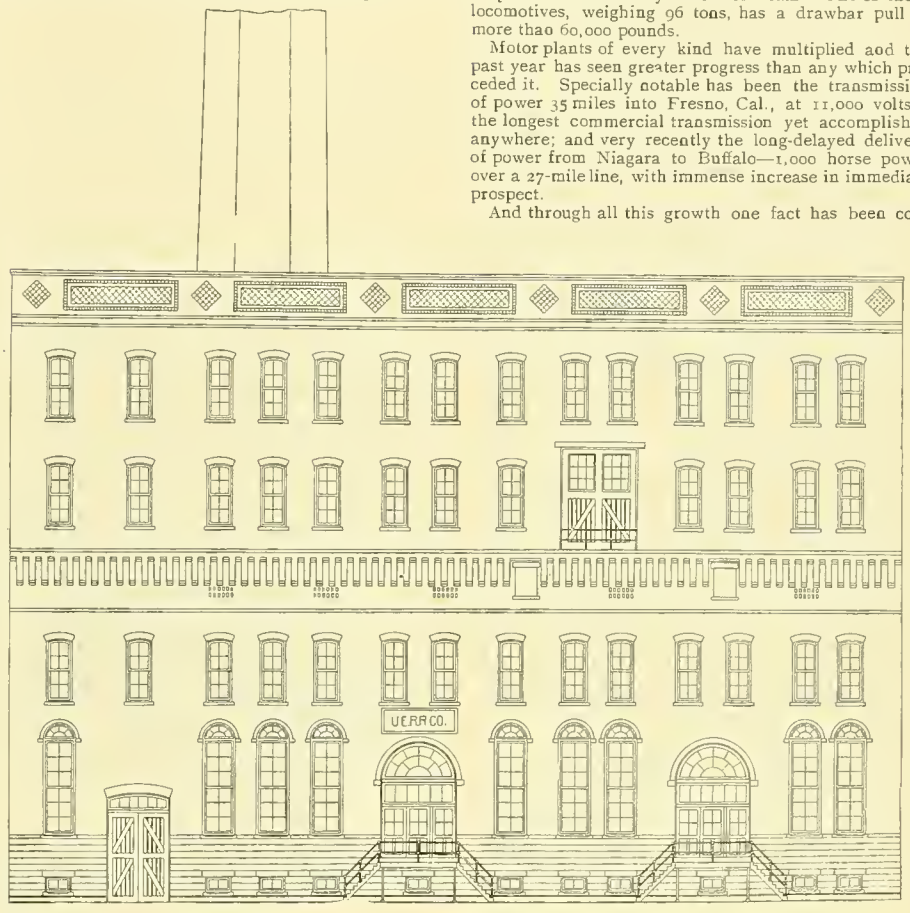

FIG. 3. ELECTRICAL EQUIPMENT OF THE UNION LOOP, CHICAGO.—FRONT ELEVATION, POWER HOUSE.

It is hard, indeed, to estimate the growth of electric motive power during the last decade. In place of the little group of struggling electric roads of 10 years ago, we have to-day very nearly 13,000 miles of track equipped with not less than 30,000 motor cars. The railway motors in use aggregate fully 1,000,000 horse power, and the generating plants close to 500,000.

During the year just past about 1,900 miles of electric railway track have been built, and nearly 5,000 motor cars have been added to the equipment list. This increase means an aggregate investment of something like $35,000,000—a prodigious sum to be added to a single industry in a year that has been far from prosperous.

Of stationary electric motors the number defies exact calculation, in so many directions and from so many sources has the growth extended. A single plant in New York city carries nearly 10,000 horse power in motors upon its circuits, and the aggregate of those thus operated from central stations primarily intended for lighting certainly reaches 100,000 horse power. Those operated by scattered stations and power transmission plants, and used in miscellaneous ways, bring the probable total amount of power to 250,000 horse power. Including railway work, it is safe to say that the gross power of the electric motors used in the United States is at present not less than 1,250,000 horse power. Of power transmission plants proper, inaugurated mainly for motor purposes, there are now probably 150—about 100 of them using the modern polyphase systems, which, by sim-

plifying the question of distribution, have made power transmission practicable. A score of these plants transmit power 10 miles or more, and half a dozen over 20 miles. When we compare such a list with the little group of small power plants that were running five years ago, the strength of the cause that has scored such gains in times so troublous is self-evident.

The secret of this astonishing growth lies in the simple fact that capital will be invested to effect certain retrenchment even when it cannot be obtained for any other purpose. In prosperity men will work harder to make a dollar than to save one; in adversity this tendency is reversed.

The saving secured by the use of electric power is so considerable in many cases that ordinary prudence has demanded a sufficient investment to secure this advantage. One of the mining plants to which reference has been made has been paying for itself at the rate of five per cent. a month. Under many conditions electric power must now be regarded as an industrial necessity. Its position is secure, and the burden of proof rests to-day upon those who doubt.

For the future the outlook is bright. The pioneering period has gone by, and present successes render argument needless. The growth of the next few years will be along two lines. First, we shall see an enormous extension of electric railway work. The steam railroads are beginning to submit to the inevitable, and one by one we shall see them employing electricity, certainly for branch and suburban service, perhaps even on long lines.

When the public wants an express service at 100 miles per hour, the means is at hand, and very little experimenting will have to be done. Not less important in its effect on the people is the growth of small electric roads in the country districts, tending to check the centralization of population and industry that is so grave a cause for anxiety in our national growth.

Second, there will be in the immediate future an immense development of the natural power resources of the country. One of the curious results of the power-transmission work already accomplished has been the re-discovery of numerous water powers which were quite forgotten until electrical power transmission called attention to them. Some of these have lurked in the most unsuspected places, where all the conspicuous powers had long ago been utilized. There are unemployed water powers enough within 50 miles of New York to displace every steam engine in the metropolis at a profit, if they were but rendered available.

It is now certain that the distance mentioned can be successfully overcome by apparatus already available. The recent transmission of power 35 miles into Fresno, Cal., already mentioned, has made clear the way, and no appreciable difficulties can be met in 15 or 20 miles more. This Fresno plant, notable as the longest transmission in the world, is worthy of further description. The motive power is obtained from Pelton wheels working under an effective head of more than 1,400 feet. Each wheel is directly coupled to a three-phase generator, delivering current to the raising transformers at a pressure of 700 volts. It leaves the transformers at 11,000 volts for its long line through the foothills and the San Joaquin valley into Fresno.

The present transmission is about 1,000 horse power, devoted to the distribution of light and power in Fresno and neighboring towns. Until this line went into operation, there was some distrust of very long-distance work, some fears of unexpected and unpleasant developments that might be met on very long alternating current circuits. These fears have now been finally dispelled by success, and, long before the power of Niagara was delivered in Buffalo, the success of that momentous enterprise was made certain, so far as electrical difficulties go, by the experience acquired in distant California.

With the power of overcoming long distances that has now been gained, a field is opened for the employment of electric power, the extent of which nothing short of prophecy can estimate. Not less than 5,000,000 hydraulic horse power is ready to be utilized in this country of ours when industry calls for it. Water power, to be sure, is not invariably a cheaper source of energy than coal, but the chances are generally in its favor.

And when water power is unavailable, there remains the splendid possibility of transmitting electrical energy instead of hauling coal—taking the fuel at the pit's mouth and using it to spin electric motors in the thousand factories of a city 50 or 100 miles away. The first steps have been taken in this direction already, and some progress, at least, is certain. The time has come when cities will begin to defend themselves against the defilement of the free air. The smoke palls that hang gloomily over most large cities are blots on our boasted civilization, and they are to-day without the excuse of necessity or economy. More than this, they have passed beyond the bounds of toleration, and the general tendency of municipal legislation is now to enforce the remedy which hygiene, comfort, and domestic economy unite in demanding.

There is no good reason why every wheel that turns within the limits of a large city should not derive its motive power from a plant far beyond the city limits. Moreover, at prices now reached not infrequently by electrical transmission plants, heating by electricity becomes economically practicable. With heat, light, and power derived from a single great plant, almost ideal conditions are realized, and such a possibility is now within our reach. When so splendid a goal is in sight there is little chance that the advantage already gained will be lost through slothfulness and neglect, and for the great tasks pertaining to human industry electrical power will ere long have no serious competitor.

Development of the Modern Electric Railway Car Wheel.[1]

By P. H. Griffin.

The development of the electric railway wheel has been based almost entirely on the conditions of service. It has been necessary for the manufacturers to frequently accept specifications which could not be carried out to their satisfaction and with confidence in the result. This was unavoidable because in many instances the electric railway was—and still is—obliged to conform to peculiar local regulations concerning the form of rails and general construction of tracks. To get into operation at all there was no alternative but to comply with these regulations, good or bad as they might be. It was necessary to regulate curves by the width of streets rather than by a correct standard of construction. Crossings over steam railway tracks had to be made before proper agreements for right of way could be secured; in fact it has been necessary for electric railways to accept almost any conditions that would permit operation, no matter how difficult and impracticable they might be; and under such auspices the electric wheel was developed. In general section it first followed the style of the spoke wheel used in horse car service. This was 30 inches in diameter and weighed about 200 pounds. Owing to the increased weight and speed of electric cars it was soon found that heavier wheels were necessary, as well as those made from the best metal and from patterns designed with the utmost care to avoid undue shrinkage strains. Wheels 33 inches in diameter soon came into considerable use; and now the total number in service is made up of about an equal proportion of each diameter weighing from 300 pounds to 360 pounds.

The spoke pattern is still adhered to in general because nothing better has been suggested, and it seems to answer the needs of the present service very well. The spoke wheel, indeed, possesses several advantages as compared with the plate wheel. In the former the metal can be massed in heavier section than in the latter, and this permits of a deeper chill on the wearing surface. With plate wheels of like weight and ordinary section the plates would run from one-half inch to five-eighths inch thick, and if a heavy chilling mixture was used these plates would be harder and more liable to crack in service.

But there are new conditions arising from day to day, one of the most important of which is brake service on interurban railways, where speed is higher than in cities. The present local traffic brake application is a constant and most important factor in the wear of wheels, but does not as yet involve the excessive friction which occurs in high speed service and which results in the heating and expanding of wheels. This result is sure to come and should be provided for. Whether the spoke wheel will stand it or not is a question.

The subject of brake heating on steam railways is at present in active discussion owing to the proposal of the Pennsylvania Railway company to apply thermal tests to wheels to prove capacity for resisting expansion strains in brake service. The test proposed is to cast a band of molten iron, 1½ inches thick and four inches wide, against the face of the tread. Although this test is generally spoken of as something new, it is not really so, as in the writer's experience it has been used for 10 or 15 years, although hot metal bands from one-half inch to five-eighths inch thick were used instead of the heavier ones now proposed.

To apply sudden and intense heat with the heavy band described is not a repetition of conditions of service; and to make wheels to withstand strains which do not arise in service would be a mistake. The test is as well a very dangerous one in wet or wintry weather, when steam or dampness on the surface of the wheel tested would cause an instant explosion of the molten metal. It is, however, possible to make such tests with safety and to graduate them as to temperature with a very simple apparatus burning gas or oil.

In the case of electric spoke wheels the spokes are in general more heavily dished than in any other kind of service, and possibly this departure from the straight line of hub to tread may admit of the giving or bending of the spokes under expansion strains if the latter are not too severe. There can be no question that this subject is of the utmost importance and should have careful attention from electric engineers who now operate or contemplate operation at higher speeds than usual.

In general service the electric wheel receives most severe treatment, as the electric car has but four wheels compared with the steam car having eight, and each of the former really carries as great a load as each of the latter. The steam wheel merely revolves under the weight and does not have to drive it as a traction wheel. This difference in traction and carrying service means an increase of from 50 to 75 per cent. of wear. This increased wear must be sustained on less than one-half the width of wearing surface and one-third of the flange dimension possessed by the standard steam car wheel.

On the electric flange falls the brunt of everything in the service. While the steam flange receives wear on

1. From the *Street Railway Journal.*

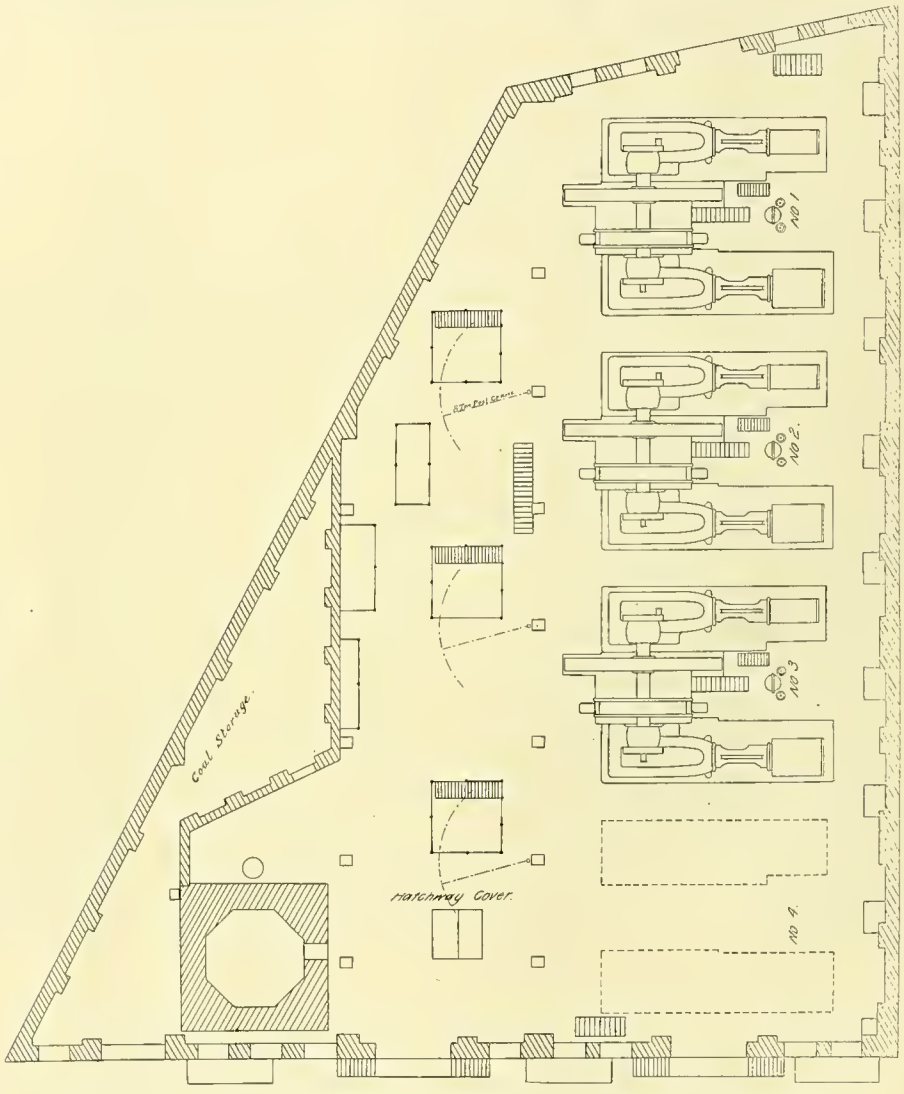

FIG. 5. ELECTRICAL EQUIPMENT OF THE UNION LOOP, CHICAGO.—PLAN OF ENGINE ROOM, POWER HOUSE.

the inner face only, the electric flange receives it everywhere. It must grind its way through curves where the long rigid wheel base and short curve radius permit only a forced passage. It makes loud complaint, as everybody knows who happens to live near such a spot and hears the shrill screech caused by the friction of flange and rail. For the flange of a steam wheel to strike on its point, much less to do service of this kind, would be deemed so dangerous that no railway engineer would take the responsibility of it for a moment; but the electric flange must constantly do service of this kind.

As yet electric and steam railways are not on such friendly footings as to permit the laying of the usual and proper crossings over the tracks of the latter. Right of way is yet in many cases an open question, and electric cars are only permitted to bump and jolt over the steam tracks as best they can. In such cases the electric flange must carry the entire load, receiving it as a sharp blow delivered by the entire weight of the car and its passengers. It is not practicable to make the flanges heavier or the treads wider as long as the present section of rail is used; there is indeed more likelihood of smaller instead of larger sections being used in the future.

It will be seen that the present electric wheel has to perform a task that is constantly increasing in severity, and there is little possibility of any provision being made to meet it, except in the general quality of the wheel itself. Everything else can be made heavier and stronger —motors, trucks, car bodies, etc.—but the tread and flange of electric wheels are apparently fixed quantities for city traffic.

With the extension of electricity to interurban service the conditions promise to increase in difficulty. When cars run over city tracks into the country, the wheels must conform to the tread and flange section used in the cities, in order to pass over the tracks. Thus a new kind of electric wheel will be required—one that can meet the requirements of both cities and country—of ordinary and high speed service.

The question of the flange appears to be the most difficult of all. It demands a metal containing every quality possessed by chilled iron, wrought iron and steel, and it must have maximum toughness and hardness. Chilled iron gives the best wear, as it is the hardest of all materials. Ordinary steel wears more rapidly, especially on the light flanges. Special qualities of steel, such as manganese steel, are now manufactured into wheels and have been tried by several of the larger companies.

With chilled iron the trouble is chipping or breaking of the flanges, some railways finding trouble of this kind and others not. Local track conditions seem to be principally responsible for the result. If there are steam tracks to be crossed where proper crossings are not provided, chipping is likely to result.

Chilled iron in its wearing capacity varies according to the quality of the material used and the skill and experience in manufacture. When the former is the best and the latter sufficient to control the depth of chill so as to have it proper and uniform, the results are good; but if mixtures are made to produce wheels that can be sold at a low price, then results are certain to be irregular and often very bad.

Solid cast wheels of ordinary steel have not been used at all in this country, and very little elsewhere. Built-up steel wheels have been tried in one or two instances to a considerable extent. Sixty cars on one of the large Pittsburg lines were equipped with steel wheels some few years ago, but the heavy wear on flanges caused the removal of all of them within a few months. In Europe, where steel tired railway wheels are generally used in most countries, it is natural that a modification of the heavy steel wheel should be tried for electric service; but as local conditions in regard to track construction are, if anything, more stringent than in America, it is likely that the result will in the end be harder on the steel wheel. The rail with the flaring side to the groove, so common in America, is not allowed in Europe, but one with a deep narrow groove not over seven-eighths inch wide, and with sharp corners, is used. Necessarily flanges cannot be over five-eighths inch thick. How successfully steel flanges will resist these conditions remains to be seen. The general construction of steel wheels used on electric railways in Europe is thus far also very light, and engineers have still to realize that a light wheel of many parts will not do the work. With the general section in use, not over 20 to 25 tons of pressure can be retained by the hub even if double that amount is used in forcing the wheels on the axles. This is because there is no rigid support from the remainder of the wheel as in the case of chilled wheels which are made in one solid piece. The constant starting and stopping is therefore sure to tell heavily on the connecting parts of the light steel wheels. Chilled wheels are also in use to a considerable extent—perhaps half of all in service—and in proper time the question will be decided on its merits.

An Apparatus for Illustrating Phase Differences.[1]

By Louis Derr, M. A.

When an harmonic electromotive force is applied to a circuit of ohmic resistance R, inductance L, and capacity C, there exists in general a phase difference θ between the electromotive force and resulting current, whose magnitude is expressed by the equation

$$\tan\theta = \frac{Lp}{R} - \frac{1}{C\,Rp},$$

in which p is a quantity equal to 2π times the number of alternations of the current per second. From this equation it appears that θ may be positive, negative or zero, according to the relative magnitude of the two terms. If the circuit consists of an impedance coil, the second term is negligible, θ is positive and the current is behind the electromotive force in phase; if the circuit contains a condenser only, the second term predominates, θ is negative and the current is ahead of the electromotive force.

To show these and other phase relations on a scale suited to lecture room illustration, the apparatus here described has been devised by the writer, its operation depending on the principle that when an electric current is sent through a wire lying perpendicularly across a magnetic field a force is developed which urges the wire at right angles to both the direction of the field and the current. A powerful electromagnet is mounted on an upright stone base, and a wire is stretched across the field between its poles. At the top of the apparatus the wire terminates in the free end of a light metallic hinge, to which a small mirror is cemented The to-and-fro vibrations of the wire may be observed by a beam of light reflected from the mirror to a screen, the hinge preventing all lateral motion and twisting. The other end of the wire carries a tuning-pin and a device providing a slight angular motion of the whole wire for adjusting the mirror.

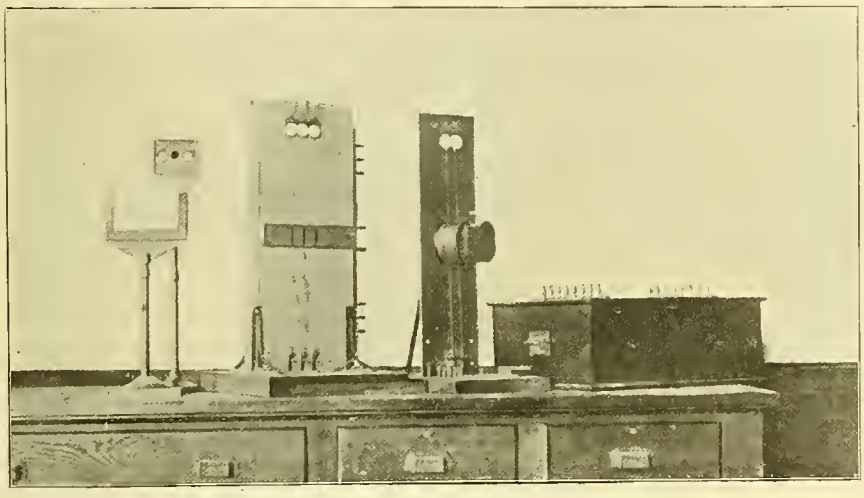

FIG. 3. AN APPARATUS FOR ILLUSTRATING PHASE DIFFERENCES.

An alternating current sent through the wire urges it alternately backward and forward, and if the tuning-pin is turned until the period of free vibration of the wire coincides with that of the current the wire springs into vigorous and distinctly audible vibration, and the spot of light reflected from the mirror on the screen elongates into a vertical line. That this line is traced by the moving spot is easily shown by putting in the path of the reflected beam a mirror revolving about a vertical axis, and thence reflecting to the screen. On turning the second mirror the successive positions of the spot fall in different verticals, and the result on the screen is a very perfect sine-curve, a faithful representation of the vibrations of the wire. Fig. 1 shows the arrangement of mirrors, using two wires.

With two such wires the observation of the phase difference between two currents is easily made. With everything at rest the mirrors are adjusted until the spots of light reflected on the screen are coincident. If now the wires are connected into separate circuits carrying currents, the lines of light on the screen remain superposed, the one corresponding to the stronger current appearing slightly longer than the other. On turning the revolving mirror any phase difference between the currents is at once shown by the horizontal displacement of the lagging curve past the other, exactly as text-book diagrams of such curves are drawn.

To observe phase differences between voltage and current under various conditions, one wire is connected to the terminals of the given circuit through a suitable non-inductive resistance. The resulting current will then be sensibly in phase with the applied electromotive force, and the curve on the screen may be taken as representing the changes of the electromotive force itself. The other wire, shunted if necessary, carries the current to be studied. One of the curves on the screen may be colored and thus identified by putting a slip of colored glass in front of the corresponding mirror.

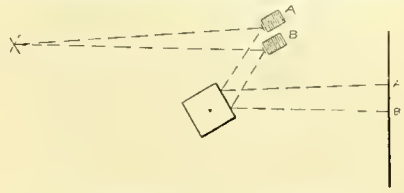

FIG. 1. AN APPARATUS FOR ILLUSTRATING PHASE DIFFERENCES.

The phase relations between voltage and current in circuits of different character may be conveniently compared by using a three-point switch and connections as shown in Fig. 2, where L represents an impedance coil, R a non-inductive resistance, and C a condenser. The circuits can thus be interchanged as rapidly as desired; and the instant shifting of the curves on the screen, corresponding to the character of the circuit employed and agreeing with the conclusions of a preceding paragraph, is quite striking. With the apparatus here shown a current of one ampere in the wire and a total length of about 30 feet in the reflected beam give curves on the screen of two feet amplitude.

The angular relations between the currents in a polyphase circuit may be shown to an audience if the necessary number of mirrors is employed; the reactions of condenser and impedance coil upon each other in a circuit adjusted for resonance may be illustrated if a high voltage condenser of large capacity is available; and the phase relations between the primary and secondary voltage and current of a transformer may be demonstrated. Fig. 3 shows two-wire and three-wire apparatus, together with the 17-microfarad condenser and color screens used in the experiments. A foot rule is also photographed to show the size of the instruments. Exact dimensions are not given, as the size of every part may be varied within wide limits.

It should be stated that the results given by the apparatus in its present form are not quantitatively accurate within several per cent., especially if the currents in the wires are not truly sinusoidal.[1] The discrepancies between calculated phase differences and those observed with the apparatus, while unfitting it for precise measurement, do not, however, interfere with its usefulness as an instrument for purposes of illustration.

1. From the *Technology Quarterly* for December, 1896.

Not Yet Consolidated.

The Western Electrician is in a position to say with positiveness that the rumored consolidation of the Fort Wayne and Siemens & Halske companies has not taken place. Negotiations to this end may be in progress, and probably are, but the combination has not not been effected as yet, and the prospects of its going through or failing may be said to be about equal at this writing. During the last week in December a hint was dropped to the Western Electrician that such a move was in contemplation. Since then this journal has kept a close watch for interesting developments, and it can be depended upon that the statement of an enterprising eastern contemporary to the effect that the two concerns have already come together is decidedly premature.

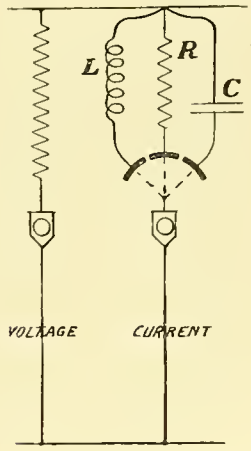

FIG. 2. AN APPARATUS FOR ILLUSTRATING PHASE DIFFERENCES.

1. Thesis of Messrs. Fish and Libby, 1895.

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EXPERIENCE seems to justify the belief that it is poor policy for a street railway corporation to attempt to improve the financial condition of its property by reducing the number of cars operated. Many companies, especially in small cities, have done this during the hard times, and the reports from these properties show a gradual falling off in patronage. In several cases where the service has been impaired by the withdrawal of cars, people who formerly rode regularly now make it a rule to walk when possible, and they invariably give as a reason the "unreliability" of the service, or rather, they should say, the fact that they could not depend upon getting a car when they wanted it. Thus they are compelled to make allowance in time that will enable them to walk to their destination. This, of course, is a condition which the street-car companies strive to avoid. They do not want the people to walk, but the only way to secure and increase patronage is by giving quick service and frequent trips. Otherwise the companies might just as well go back to horse cars.

ADVICES from London indicate that the report of the Pacific cable commission has been completed and will be submitted to the government for approval. It is understood that the report favors laying a cable at the earliest possible moment between Vancouver and Australia, under joint subsidies by England, Canada, the Australian colonies and New Zealand, touching none but British territory and leaving Hawaii to be tapped by a branch line. Canadian support was given the project conditional upon the absence of foreign stations, which would destroy the strategic value of the cable to the empire in case of war.

Considerable difference of opinion was shown upon the question of providing funds for the enterprise. The cable will cost $10,000,000, it is estimated, and the Canadian delegates strongly favored the construction and operation of the cable as a joint government enterprise by an imperial colonial cable trust, England, Canada and Australasia each paying one-third of the cost. English official opinion, supported by some of the Australasian colonies and backed by strenuous opposition to the existing Eastern company monopoly, urges the granting of a subsidy to an independent company. These differences may delay final action upon the subject so that the United States may command the situation by being first in the field.

IT would seem as if any person who has lived in Chicago long enough to have become eligible to public office should be impressed with the fact that it is simply out of the question to enforce the provisions of such an ordinance as that recently introduced in the City Council providing for the regulation of the number of persons who may ride upon a street car. There can be no doubt that if the terms of such a measure could be complied with public comfort would be greatly promoted. People will crowd into cars as long as there is standing room, and the street railway companies are entirely satisfied that they should do so. A prominent street railway magnate of Chicago is reported to have taken the stockholders of his corporation into his confidence to the extent of assuring them that it was not the persons who occupied seats in street cars who made it possible to pay the dividends, but those who clung to the straps. Under the circumstances it is not strange that the measure mentioned does not receive enthusiastic support at the hands of street railway corporations. The objections to the ordinance are so apparent that they are recognized by some of those who favor the spirit of this provision. The *Chicago Record*, for instance, says editorially:

In European countries such regulations are enforced, but it is to be feared they would not be popular in this city. The average Chicagoan would rather stand than have to wait any considerable time for a seat. The companies doubtless would manage to increase the unpopularity of such an ordinance, if enforced, by still running too few cars and making the delays intolerably long.

It is suggested, however, that a better way to bring about the desired result would be to require the companies to run more cars and with sufficient frequency to accommodate passengers. It is admitted that at certain hours of the day it would be impossible to provide a sufficient number of cars to enable each passenger to occupy a seat, but it is contended that the service could be materially improved without working hardship to the companies.

NO ONE can cavil at the soundness of the decision of the Court of Appeals of Kentucky, just reported, on the imperative necessity of complete insulation for electric conductors at all points where the circuits are exposed to inadvertent contact with men or beasts. Electric wires are now so widely distributed that it is obviously the duty of the electrical companies to afford every reasonable protection to the public. The decision of the court was made in the case of McLaughlin against the Louisville Electric Light company, which was an action brought by a painter to recover damages for injuries sustained by a shock caused by coming in contact with an alleged insufficiently insulated wire when in the act of getting out of a second-story window onto an iron cornice to do a little touching up there.

The court says that the evidence conduced to show that the plaintiff was at work at his regular trade, and was where he had a right to be, and that the joint of wire there, being apparently insulated, was to some extent, at least, a guaranty that there was no danger; but, independent of that fact, his situation, his work in hand, and the proximity of the wire, were such that he might without negligence have thoughtlessly taken hold of the wire, because he seemed to need support; and, besides, it was hardly to be expected that the current was on the wire at about noon, the wire being used wholly to supply incandescent lamps. And the court adds that it also seems clear to it that the electric light company should have been required to have had perfect protection on its wires at the point and place where this man was injured. The fact that it was very expensive or inconvenient, it declares, was no excuse for such failure. Very great care might be sufficient as to the wires at points remote from public passways, buildings, or places where persons need not go for work or business; but the rule should be different as to points where people have the right to go for work, business or pleasure. At the latter points or places the insulation or protection should be made perfect, and the utmost care used to keep it so.

AN objection to the introduction of the electric light in England that is giving considerable trouble to the construction and central station companies is the unwillingness of prospective patrons to discard gas fittings and fixtures and substitute at their own expense the necessary electrical fixtures, wiring, etc. The cost of installing the electric light is the value of the gas fittings discarded, which, of course, become useless, in addition to the payment to the contractor for the new work. Many men find it inconvenient to make such payments in a lump sum, while they would for many reasons be glad to change their system of lighting. In order to meet this difficulty some corporations and companies have arranged a system of free wiring, increasing the charge per unit of electrical energy consumed in order to recoup the initial outlay and interest thereon. This plan is favored by the London *Electrical Engineer*, provided the charge agreed upon is not too one-sided. Attention is directed to the fact that corporations can easily borrow money at three per cent., so that business of this kind would amply repay them. But, our contemporary inquires, is such a return just to the consumer? And it adds: "We think not, and should expect to see corporations at any rate putting a limit of time upon the extra charge per unit. If they got an eight per cent. return upon the expenditure, a part of that return should be used to pay interest upon the capital borrowed, and the remainder used as a sinking fund to repay the capital. When such repayment was completed the customer ought no longer to be charged the extra amount." By this arrangement, it is contended, "the customer would be benefited in that his payments for installing would be spread over a time, rather than being paid in the lump. The corporation would reap a large reward in that the output of the station would thereby be increased, and the larger the output the less the total cost." Experience of central station managers in this country leads to the belief that such an arrangement would be unsatisfactory at best, and in many cases positively detrimental to the business. The plan followed in the early days of electric lighting proved a costly experiment and is not likely to be repeated in this country.

WITH the opening of the Legislature of the state of New York comes the announcement that "telephone legislation to break the power of the Bell monopoly will be revived at Albany this year," and it is added that "the chances of securing a reasonable charge for telephone service are better than ever before." This seems to be regarded as a notice to the telephone company that the legislative lobby would renew its attack upon the Bell interests. The promoters of the proposed measure claim, of course, that the movement is really in the interest of the people, and that it is not intended as a blackmailing scheme, as has been intimated. These men say that the fight two years ago was an open one by the people, and that the Bell company left no measures untried to defeat the bill, succeeding in its purpose by methods that were notorious and scandalous, even in legislative circles. The same sort of opposition may be expected this year, it is admitted, but the champions of this measure, profiting by the experience of former years, say they know how to guide the bill through the legislative shoals.

Those who have closely followed the legislative attacks upon the telephone monopoly in New York in former years discredit every movement of this kind, for the reason that these bills generally find their way into a committee controlled by the lobby. Heretofore it has been customary to secure the support of members of irreproachable character, and, generally speaking, some such member was induced to introduce the measure. The agitation in favor of the bill was then carefully worked up, and an honest sentiment for some measure of relief was displayed. At this point of the proceedings the lobbyists would come forward, secure control of the bill by having it referred to a committee, and then kill the measure or so change it that it would not be acceptable to those who inspired it. Thus the movement, although originally supported by honest members, would be turned into a blackmailing scheme. Under the circumstances the only hope for those who favor this plan seems to be in the chance that the agitation for some measure of this kind may develop such unexpected strength that the lobby will be unable to control it. Of course such an event is not to be expected, but stranger things have happened at Albany.

Electric Railway Work in Switzerland.

One of the first of the mountain roads in picturesque Europe was the line from Meckenbeuren to Tettnang, near Lake Constance, which is utilized for both freight and passenger service and has given abundant proof of the superiority of electricity for such purposes. The road is equipped with an overhead trolley system and its service consists of 26 trains daily between terminals. In addition to the railroad service a central station furnishes current to the two towns for light and power.

The generating station is operated by an hydraulic installation at Brochenzell, upon the river Schussen, where by means of a dam a fall of 2.65 meters is obtained and 120 horse power developed. The race approximately measures 700 meters and furnishes six cubic meters of water per second. The installation comprises two turbines of 45 and 75 horse power, having vertical valves, the larger having also an annular regulator. These two turbines are coupled at the two extremities of a shaft through conical gearing, the shaft being capable of separation at its center, when desired, by means of a sleeve.

In Fig. 1 are shown one continuous current dynamo of 45 kilowatt at 700 volts, for the railway service, which can be run as high as 60 kilowatts, and one simple alternate current machine of 40 kilowatts at 2,100 volts with revolving field and exciter direct-connected. This latter machine furnishes current for light and power at Tettnang.

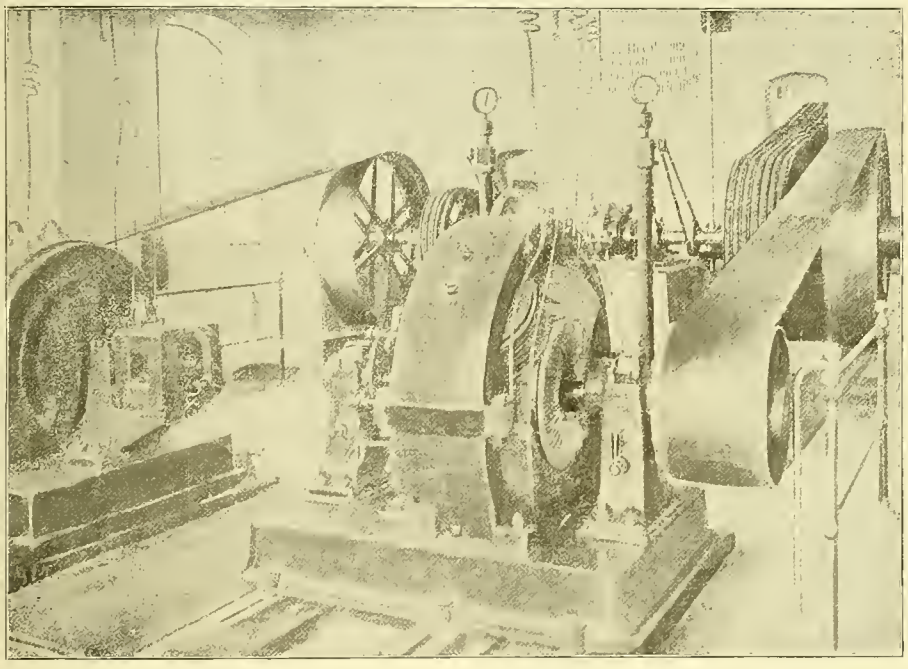


FIG. 1. ELECTRIC RAILWAY WORK IN SWITZERLAND.—STEAM AND ELECTRIC PLANT.

The switchboard at this station, shown in Fig. 2, is of marble, with a wood frame and base, the right division serving the railway, while the left panel controls the light and power distribution.

The transmission before mentioned is generally separated into two parts, the 75 horse turbine furnishing current for the railway, while the smaller generates current for lighting.

In case of low water in the Schussen, a steam outfit at Tettnang is pressed into the service as a substitute for water power. This steam plant consists of one tubular boiler of 68 square meters heating surface, an engine of 60 effective horse power, one constant current dynamo, and one simple alternate current machine—the plant being a duplicate of that at Brochenzell. These two plants are readily coupled in parallel when needed.

The energy generated at Brochenzell is transmitted to Meckenbeuren by two overhead lines, and thence along the road to Tettnang, where the conductors terminate at the switchboard of this central station. The conductors are carried on poles upon one side of the road, while poles on the opposite side carry the telephone wires. These two lines of poles are united by iron cables which support the trolley line at a height of 5.5 meters above the rails. In the station this line is mounted on special brackets of iron.

At Meckenbeuren and at Tettnang one pole of the dynamo is connected through the rail to ground, while the other pole is connected to the feed wire, which at each 200 meters is connected with the trolley line.

To better insure the electrical contact between the rails the ends are carefully riveted by a special copper attachment, so that the ohmic resistance of the line is but 0.01 of an ohm per kilometer. Two cut-outs are placed at the extremities of the line, protecting both the feeder and trolley lines, and the stations are similarly protected.

The total length of the line from Brochenzell to Tettnang six kilometers, that of the road 4 5 kilometers, all on is an incline 2 4 kilometers of the line having a grade of $\frac{1}{20}$ and the sharpest curve being of 180 meters radius. The rail has a weight of 21.96 kilogrammes per running meter. The road is abundantly supplied with side tracks and passing places. The rolling stock of the road consists of freight cars and automobile engines. For economical reasons the motor cars are constructed like passenger coaches, with mail and baggage compartments. They are equipped with two motors of 24 horse power each, and these being constantly in series the electrical outfit is most perfect and safe, and the combination of switches, cut-outs and lightning arresters furnishes abundant protection, while the rheostat attachments permit of the most perfect regulation of speeds within very large limits. The cars are lighted electrically (six lamps of 100 volts each in series), and electric heating is to be adopted.

The total weight of the motor car is 13,800 kilogrammes; the distance between axles is 4.5 meters, and the two motors can develop a pull of 350 kilogrammes at a speed of 30 kilometers per hour, or 1,200 kilogrammes for a speed of eight kilometers per hour—freight service speed. These figures have been exceeded in practical work.

Below is a table of speeds at different loads, showing the efficiency of the motors under varying circumstances:

	Weight of the train in tons.	Trip run, Minutes.	Speed in Kilometer Hours.			
			Mean.	On Grades.		
				$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{50}$
Motor car alone	14	12	22	29	24	19
" with trailers	33	18	15	21	18	14
" " "	46.4	21	15	22	15	10.5

The lighting service of Meckenbeuren and of Tettnang is assured by two alternators, one at the latter place and one at Brochenzell, which may at will be coupled in parallel.

The simple alternate current has a tension of 2,000 volts, and is carried, by means of lead double covered cable with an armor of iron, to nine different transformer stations, like that shown in Fig. 3.

The secondary lines are carried on poles or brackets on buildings; the tension of the secondary current is 110 volts.

There are several points of interest along the road and many picturesque scenes. An idea of the construction through the country and the appearance of a train en route is presented in Fig. 4 (p. 36) A view of the station at Tettnang, shown in Fig. 5, is a fair representation of the general order of stopping places in that locality.

Technical Education in England.

Considering the subject of technical education, *Engineering* of London contends that an altogether unnecessary amount of money has been spent in building fine buildings and elaborately equipping laboratories, since all the technical education required by the average artisan is "some elementary knowledge of the principles underlying his work," a knowledge which could

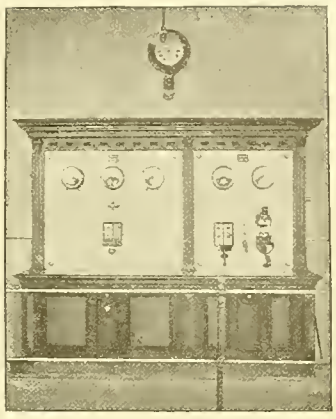


FIG. 2. ELECTRIC RAILWAY WORK IN SWITZERLAND.—SWITCHBOARD AT BROCHENZELL.

have been instilled into him either during his board school days or after hours in existing board schools, the extraordinary artisan being provided for by an extension and improvement of the science and art department system of classes and scholarships. According to *Engineering*, the money should have concentrated upon the training of the leaders of the industrial army; "it is the leaders that count," it says. Commenting on this view, which to most Americans will seem selfish and narrow, ill calculated to advance the true greatness of a nation, the London *Electrician* says:

It is impossible not to agree generally with the position here taken up, and it is, moreover, one which had the support of no less an authority than the late Professor Huxley. In no instance do the narrow business instincts of Englishmen more quickly come to the front and stay there than where the endowment of science or technical education is concerned. When a man of moderate means has £10,000 to invest he quite rightly refuses to put it all into one basket. And, similarly, when £10,000 are available for the advancement of scientific or technical knowledge the almost irresistible tendency of 12 average Englishmen is to split it up into a number of minute doles. Ten thousand pounds will not go far in equipping a really first-class engineering laboratory, let alone its permanent endowment and support, which so many altogether forget, nevertheless the don't-put-your-eggs all-in-one-basket principle is rigidly applied, with the result that England bids fair to be covered with a superfluous number of half-equipped, unendowed laboratories, to match its numerous half-finished, badly-endowed churches.

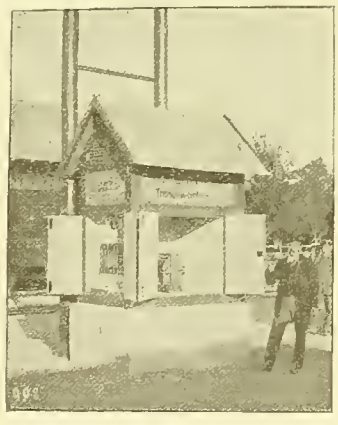


FIG. 3. ELECTRIC RAILWAY WORK IN SWITZERLAND.—TRANSFORMER STATION.

Result of Experience.

[From the New York *Sun*.]

The cable car accident of Tuesday, like its predecessors, shows that the cable ought to go. Let us have electricity, or compressed air, or something else; but not the cable.

The *Springfield Republican* announces that an electric road will soon be built to the summit of Mount Tom, near Holyoke, Mass.

Continuous Rails.[1]

Probably every engineer can remember the time, in his childhood, when he wondered what was the reason for the gap between railway rails at the joints, and when he was duly instructed in the phenomena of thermal expansion and contraction, and their influence on the dimensions of that gap. No doubt his instructor conjured up in his infant mind the disastrous consequences which would befall the train which should be driven, on a hot summer's day, along a line that had been laid in winter without the precaution of making regulation gaps at all the joints. He was told how the rails would expand, how they would lift and "hog" and buckle, and what evil things would happen to the gauge; and, convinced, no doubt, partly by the force of superior authority, and partly by apparently unanswerable lecture experiments, he grew to accept the rail-joint gap as an absolute essential in railway construction. Or, if he doubted, was there not the irresistible argument of the different appearance of the joint in winter and in summer? Nothing more was necessary to prove that the rails expanded, and expanded very appreciably. Since our childhood's days Nature has not made any alteration in her methods. Lecture experiments and railroads alike prove that the expansion of heated metal rails still happens. Yet, strange to tell, there has arisen a school of railroad engineers who teach that the gap is no longer necessary at the joints, and that continuous rails do not spell havoc for the gauge nor disaster for the rolling stock. Nor are these mere theorists, who would defy Nature with mistaken equations; for there are already in existence many tramways, and many hundreds of miles of track, every rail-joint in which forms a continuous metallic connection between the rails. True, these lines are in America, where the average British engineer cannot look at them; but, if repeated authoritative declarations are to be believed, as, in good faith, they should, a considerable degree of success has been attained.

Several reasons have operated to recommend the use of strongly united or welded continuous rails as contrasted with the ordinary fish plate or angle bar jointed rails. These may be divided into mechanical and electrical reasons. Considered from a mechanical point of view, the ordinary bolted joint is a constant expense and source of trouble. In itself it offers very little strength, and the pounding of wheels carrying heavy loads ove rthe joint sooner or later causes a depression of the rail, a flattening of the rail-ends and a distortion of the gauge. If the joints are made breaking, the cars are subjected to a disagreeable side-swaying motion; if they are "opposite" the track soon produces a jerky and jolting motion; while the constant and heavy pounding of cars passing over the joint makes it necessary to keep an army of platelayers to tighten up the bolts and to trim up the gauge and levels. Consequently, to produce smooth and regular movement of the cars, as well as to minimize track maintenance expenses, some improvement upon the ordinary bolted joint has long seemed necessary.

But the main trouble has been to get round that very inconvenient law of Nature which operates to make rails alter in length. Long before existing methods of making continuous rails had been introduced, various attempts were made to obtain a smooth track and rigid joint, by means of composite rails or by elaborate hot riveting. Joints of the latter kind were used, in 1891, on the Lynchburg & Durham steam railway, and about the same time on one of the Cleveland electric lines. It is stated that these experiments gave satisfaction; but, notwithstanding this, the method was not extensively adopted. Composite rails were also tried in one or two places, these mainly consisting of rails built up of two or three parallel pieces, so arranged as to break joint, and thus to form a continuous and smooth bearing for the wheels. But the low mechanical strength and small rigidity of this type of rail limit its use to where only very light rolling stock is used.

The gradual spread of electric traction, however, created another important reason why metallically continuous rails should be preferred to those with ordinary joints, or even to such forms of continuous rails as have just been described. To insure a minimum loss of power in the return electric conductor, where the track was used as such a return, it was of prime importance that the joints should be of low resistance. Where ordinary bolt-joints were used, this desideratum could, of course, be obtained—at some considerable expense, however—by means of copper bonds. But the possibility of making tracks, presenting in themselves a continuous metallic conductor of low resistance, was an additional temptation to the electric railway man to adopt them on his lines. This possibility was brought about by the commercial development of electric welding on the Thomson principle; and it was not long after electric welding had become a recognized engineering operation that it was tried on tramway lines. Among the first, if not actually the first line to be equipped with electrically welded rails was the West End tramway of Boston, on which, in 1893, several miles of track were provided with weld-joints. The success was only partial, many of the welds giving out, and, in some places, the rail itself being fractured close to the weld. The Johnson company, which had taken the lead in this class of work, persevered and brought it to a higher degree of perfection, so that in the early part 1894 there were already several tramways equipped with electrically welded tracks, and a number of other American lines were adopting them. So perfected, indeed, had the process become that it was adopted even for important and long lines, as, for example, in July, 1894, for the Nassau electric railroad, on which it was intended to electrically weld some 60 miles of track, of which no less than 35 miles were actually completed in the summer of that year.

Considerable time—though not much in proportion to other methods of welding—was occupied in welding a track by electricity; in general each welding machine would do no more than from 30 to 50 joints per day of 10 hours. During the actual welding operation, which took about two minutes, an enormous amount of power was consumed, with the result that the operation was not as cheap as could have been desired. These, and perhaps other considerations, have given no little impetus to a rival method of rail-welding which has recently been adopted on several important American tramways, and about which considerable discussion has lately taken place among electric traction men in the United States. We refer to the Falk system of "welding" joints by casting a large quantity of pig and scrap iron around the abutted ends, a system which is somewhat inconclusively termed "cast-welding." In a valuable paper on "Track and Track Joints," read by M. K. Bowen before the American Street Railway association last October, the Falk system is described. We learn, too, from another source, that no less than 89,410 of these joints had been used on American lines up to the beginning of the present month; also, that some French tramways are about to be "cast-welded." But we confess that we are not particularly smitten with admiration of this method of jointing rails; although quite prepared to give credence to the mass of practical evidence in favor of its success. It is pleasing to learn that at St. Louis some 13 miles of track have been cast-welded so successfully that no bonding has been found necessary, and to be told that out of 17,000 such joints put in, in 1895, at Chicago, where the variation of temperature is extremely great, only 154 have failed. But a joint which requires from 100 pounds upward of cast-iron to be lumped around and under the rail-ends cannot commend itself to our English ideas as mechanically perfect, and one that seems to cost $3.25 per joint—as stated by Mr. Dodge, in the discussion—does not strike one as having reached the pinnacle of financial economy. Perhaps, however, when the system is freed from royalties on patents it will prove considerably less costly. As regards the necessity for using special bonds on cast-welded electric lines, there seems to be some diversity of opinion, even among engineers who have made practical trial of this joint. But there is a considerable balance of evidence in favor of bonds being superfluous; and on the principal cast-welded tramways in America no bonds whatever are used, the resistance of the cast joint being often lower than that of the rail itself.

Speaking generally of continuous rails, we are inclined to think that these are more favored by the conditions of American track construction than by the conditions which maintain here. There are many points of divergence which might support this view, but we may refer particularly to the difference in grade of steel used for the rails. In the United States there has for some time been a tendency to adopt, for tramways and railways, a higher and higher grade, or a harder and stronger, though more brittle, quality of steel. In this country, however, we prefer to use milder and more ductile qualities, of a softer surface and having a lower elastic tensile strength. Neither in severe tension nor under compressive stress would the English rails be likely to possess so much stiffness and elastic strength as those commonly used in America, while their co-efficient of expansion is appreciably greater. As a consequence, the American rails are more fitted to resist the constraint which must be imposed on them, if they are to be subjected to extreme variation of temperature without free expansion or con-

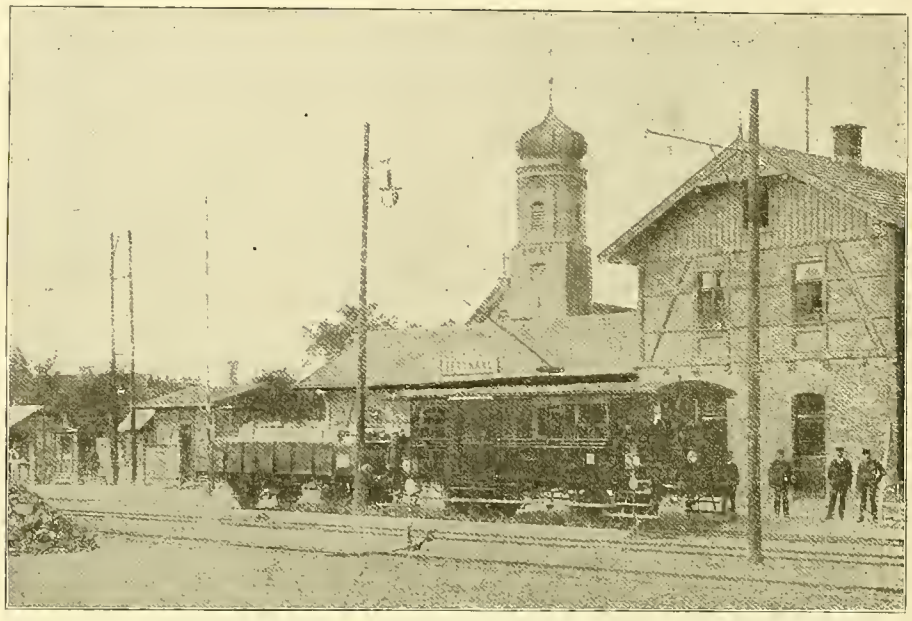


FIG. 5. ELECTRIC RAILWAY WORK IN SWITZERLAND.—STATION AT TETTNANG.

FIG 4 ELECTRIC RAILWAY WORK IN SWITZERLAND.—OUT ON THE ROAD.

1. From the London *Electrician*.

traction. That the stresses in practice are severe is proved by the fact of heavy high-grade rails snapping asunder at some distance from the joint during a cold night in winter. Mr. Littell of Buffalo speaks of 94-pound rails breaking in this way, even though only jointed with angle bars. Probably a variation of atmospheric temperature between a summer's day and a winter's night corresponds for steel of that grade to a stress of not less than 25,000 pounds per square inch, to which must be added impulsive stresses arising from the passage of cars and from the higher temperature produced by momentary heavy electric currents in the rail. It must be an exceedingly well laid, well tied and high-grade quality of rail that can stand the stresses which a combination of circumstances such as this will inevitably produce. And so long as English tramway men adhere to low-grade rails—which, we submit, are better suited to English conditions than higher grades—we fail to see that welded continuous rails, by whatever method welded, have much chance of being extensively adopted in this country.

"G E" Transformers.

It is now a well recognized fact that the loss in a given body of sheet iron subjected to a definite number of magnetic reversals per second and at a definite density of magnetization does not of necessity always remain the same. It is only by the greatest care that iron is brought into the condition in which it gives a minimum loss when subjected to alternating magnetization, and the manner in which this result is obtained, and the conditions to which it is subjected in actual use, have both to be considered to insure keeping it in this condition.

Failure to properly consider these facts will produce a transformer which may give a fairly low core loss when first produced, but which, after being in use for a short time, will give a core loss 25 per cent., 50 per cent., or even 100 per cent. greater than at the start. This phenomenon is popularly known as "ageing." A curve of results said to have been obtained on a 2,500 watt transformer is here given as a practical illustration of this fact (Fig. 1). At the time of the last test the increase in core loss, it will be seen, was 68.9 per cent. after a run of 90 days under normal conditions of commercial operation.

To reduce this loss in its transformers has formed the subject of exhaustive study by the engineers of the General Electric company at Schenectady. The result of continued experiment allows this company to guarantee its transformers as free from the serious defect of "ageing;" in most cases the loss is said to be absolutely negligible and in extreme cases not more than four or five per cent. On the same curve are given the actual results obtained on one of the "G E" standard type H 60 cycle transformers, and from this it will be seen that the loss comes within the above limit.

One of the forms which the transformer for use with high voltage currents has taken is shown in Figs. 2 and 3 of the special "type H" natural draft type, developed by the General Electric company, in its long-distance transmission work. In transformers of this type the primary coils, well taped and bound, are insulated from each other by thick layers of felt; in that shown in Fig. 2 the primary coils are eight in number. Between the coils of the primary and the secondary winding an air space of one-half inch intervenes. The whole is mounted upon a solid iron foundation and securely braced, and is then covered with a corrugated iron cylinder provided with a ventilating roof (Fig. 3).

One of the first transformers of this type has been for the past five months in service where it is necessary to reduce directly from 10,000 volts to 125 volts without intermediate transformers. It is used on the transmission lines of the Redlands Light & Power company at Redlands, Cal., to furnish low voltage current at a point some 10 miles away from the sub-station secondary lines.

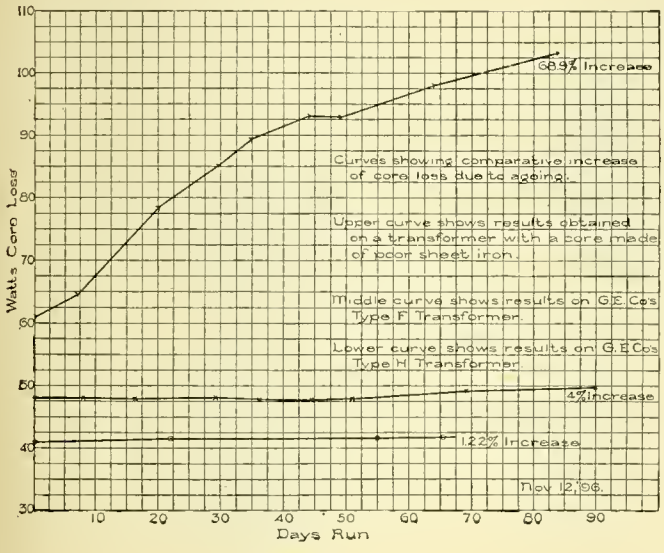


Fig. 1.

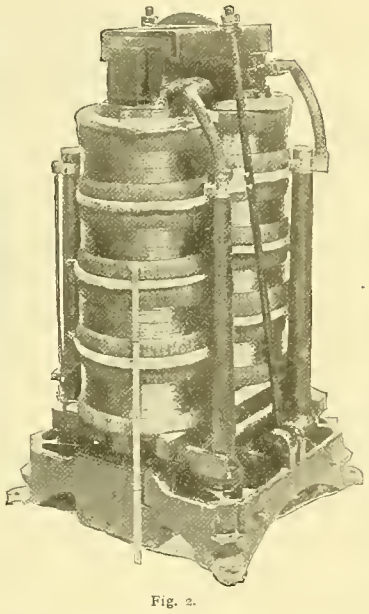


Fig. 2.

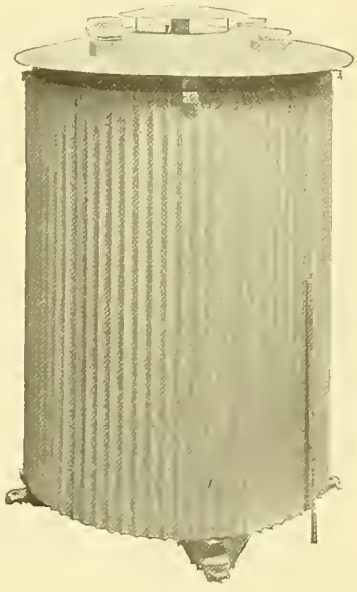


Fig. 3.

"G E" TRANSFORMERS.

The Western Union Company and the Telephone Business.

Persistent rumor attributes to the Western Union Telegraph company the intention of soon entering the telephone business on a large scale. It is said that the logic of events will sooner or later force the great telegraph company into the telephone business, as the newer method of electrical communication is gradually superseding the older one in many directions, and as the commercial situation is such that the Western Union may be compelled to take up the telephone for extensive use in self-defense. At present there are hundreds of private telephone lines operated by the Western Union company, which has furnished the circuits and Bell instruments to customers, but the company has never gone into the exchange business, being restrained, of course, by the famous agreement with the American Bell Telephone company until recently. What the company's future policy will be no one seems to know. It is not unlikely that the directors are themselves undecided and are awaiting the Berliner decision to judge of the future attitude of the Bell company. At any rate, the story published in a Chicago paper, that the Western Union company had arranged for the purchase of the plant of the Western Telephone Construction company, is pronounced to be entirely unwarranted by the president of the latter company, who declares that he knows nothing of the alleged transaction. Undoubtedly most of the other stories afloat and relating to the situation are similarly baseless.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The recent blizzard played havoc with the long-distance wires of the Northwestern Telephone Exchange company. Fully 600 miles were affected, and a portion of it was carried to the ground under the weight of ice and snow. The region most affected is between Sioux Falls, S. D., and Minneapolis and sections of South Dakota and western Minnesota,

J. A. Gaynor has submitted a proposition at Marshfiled, Wis., to build a telephone line from Grand Rapids and Centralia to Marshfield, the first two to pay three-fourths of the cost. If this proposition is accepted it is understood that Wausau will build to Marshfield and pay the entire cost.

The Southwest Telephone company of Dodgeville, Wis., is arranging for an extension of its lines in the spring through Ridgeway, Barneveld and Blue Mounds and connecting with the Dane County Telephone company of Madison. A line west is projected to the Grant County system, which is to be extended from Fennimore.

Frank B. Fobes has an automatic telephone exchange in successful operation at Albert Lea, Minn., using 100 instruments. He will enlarge by the substitution of a 200 call switchboard as soon as business will justify. The Strowger system is used.

The Northwestern Telephone & Electric company of Milwaukee is arranging for the construction of a toll telephone line from Menominee, Mich., and Marinette, Wis., to Marquette, Mich. An exchange in Marinette and Menominee is proposed.

The North Central Telephone company of Minneapolis, which was given an extension of its franchise at Mankato, Minn., has failed to deposit a check for $100 with the recorder, as required by the council, and its franchise is in jeopardy. The Blue Earth Valley Telephone company, which is to connect with it, has built into Mankato and has its line in operation.

Electrical Work in South America.[1]

Electric light is now making considerable headway in South America, and although, at present, its progress will hardly bear comparison with what has been done in Europe and North America, it is certainly making up very quickly for lost time, and will soon be very little behind either of them.

Here, in Buenos Ayres, which has not inaptly been termed the "Capital of South America," progress in electrical work is probably greater than in Rio de Janeiro, Montevideo, or any of the other towns of less importance. A considerable portion of the business quarter of this town is now provided with a public supply system which, if not so perfect as regards regularity of pressure as what we are accustomed to in England, is, nevertheless, very serviceable as a means of illumination or as a source of power.

In one of the outlying suburbs, again, we have a supply station of some 200 kilowatts capacity, which, by means of high pressure alternating current system with house transformers, supplies electricity to a number of private dwellings, and also serves to illuminate with arc lamps the roads traversed by the cables.

The system of house wiring adopted and recognized as satisfactory out here is somewhat primitive as compared with that usually seen in England, the wires being, for the most part, supported on small button insulators or porcelain cleats fixed to the walls, and the lamps suspended direct from these insulators, no ceiling rose being used, and even a shade over the lamp being frequently dispensed with.

It is somewhat remarkable that in this country, where so much is done for show, and where large sums of money are constantly being expended on gorgeous but quite useless display of all kinds, electric light installations should be done so crudely and inartistically; and

1. From the Buenos Ayres correspondent of the London *Electrical Review*.

yet, with a few exceptions, this is the case, even in the large shops, cafes and business establishments of this city. But unfinished as the usual style of indoor wiring is, it is nevertheless very reliable, the insulation being very fairly good, and the fact of having the wires suspended in the air, instead of incased in wood or other material, rendering the chance of fire from an overheated wire very much less than it is where the latter systemis a dopted.

The outdoor system of distribution cannot, I regret to say, be regarded as at all satisfactory at present. In some cases, even in the center of the city, very scantily insulated wires carrying electricity at high pressure are suspended overhead on not very secure looking insulators, and are a perpetual menace to the safety of people passing underneath. In mentioning this, however, it is only fair to say that these high pressure overhead cables have already been condemned by the municipality, and that their owners have instructions to remove them and to substitute underground cables by a certain date; but even when this is done we shall still be left with the overhead low pressure cables, which, while less electri-

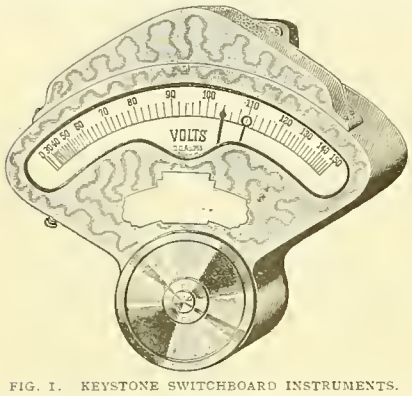


FIG. 1. KEYSTONE SWITCHBOARD INSTRUMENTS.

cally dangerous than the former, are nevertheless a great disfigurement to the town, and, on account of their excessive weight and somewhat unstable fixing, a source of not inconsiderable danger.

The price charged for electricity here is considerable, being 30 cents gold, or say 1s 3d. per kilowatt, a small discount being allowed to large consumers. This price will no doubt sound terribly high to English ears; but, it must be borne in mind that all the coal used in generating this electricity has been brought some 7,000 miles; also that the wages paid both for labor and for technical knowledge in this country are very considerably higher than what we are accustomed to in England Still when all allowances have been made there can be no doubt that the electrical supply companies must make a very handsome profit indeed.

Now that electricity has, as it were, got well started in all the larger towns of this country, it is interesting to notice with what rapidity the isolated mills and factories are also adopting electric light as the cheapest and most convenient illuminant within their reach. This is, perhaps, more especially the case in the large sugar factories in the province of Tucuman, where the nature of the business requires that work should be

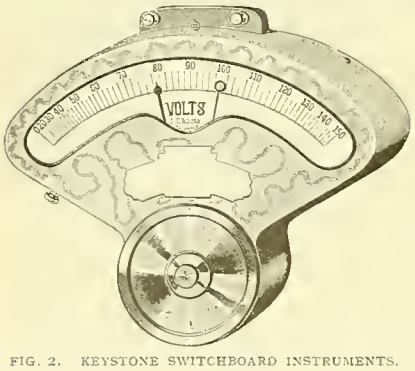


FIG. 2. KEYSTONE SWITCHBOARD INSTRUMENTS.

carried on continuously day and night during some four or five months of the year. Not long ago an installation was put up at one of the largest of these factories situated some 30 miles from the town of Salta, near the borders of Bolivia. The factory and manager's residence, which were to be lighted, were situated at a considerable distance from the National railway, which affords a somewhat precarious communication between Tucuman and Salta, so that the engine, dynamo and other requisites had to be carted for a considerable distance across country. The installation, when completed, was regarded with great curiosity, not unmixed with awe, by the half-wild Indian laborers who work in the sugar plantations in this district. It was, indeed, a most curious and incongruous sight to see these men and women crowding round the outside arc lamps when they were first lighted, and expressing their astonishment in their own curious language.

These Indian work-people are direct descendants from the original inhabitants of the country, and retain even now a great number of the habits and customs of their ancestors; living in the open air, or in tiny sheds or huts, and their clothing, which for men and women alike is of an exceedingly scant description, consisting of roughly cured skins, while their copper colored bodies are not infrequently disfigured by daubs of paint.

Vim Dry Batteries.

The accompanying illustration shows several forms of the Vim dry battery, manufactured by A. L. Bogart, 22 Union Square, New York. This battery varies in a number of details of structure from other similar cells, and a large and comparatively continuous output of current, rapid recuperation and absence of local action on open

VIM DRY BATTERIES.

circuit are claimed. Four sizes of the Vim battery are to be had, the electromotive force of each being the same (1.5 volts), but the current varies with the size, No. 1 gives eight to 10 amperes on short circuit, being the largest, and is suitable for operating coils, gas engines or large gas lighting plants. No. 2 is the standard size and is intended for all ordinary work, giving six to

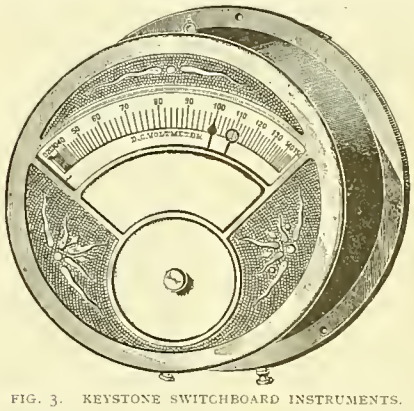


FIG. 3. KEYSTONE SWITCHBOARD INSTRUMENTS.

eight amperes. No. 3, or the "Midget," is but four inches high, affords three to four amperes, and is available for bicycle bells, lighting of kerosene lamps or wherever but small space is permissible. It may also be used in testing outfits or medical batteries. No. 4 corresponds in strength to No. 2, but, being square in section, may be laid on its side, as in electric clocks, etc. Other special sizes will be made to order to suit the convenience of customers.

Before putting these cells on the market Mr. Bogart made a careful test of them for various practical pur-

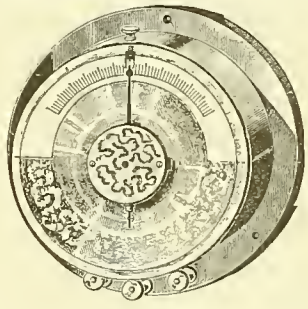


FIG. 4 KEYSTONE SWITCHBOARD INSTRUMENTS.

poses. Among others may be mentioned the operating of a two-inch Ruhmkorff coil during the entire continuance of the last American Institute Fair in New York, four of the No. 1 cells being used in connection with Welsbach lights ignited on the series system.

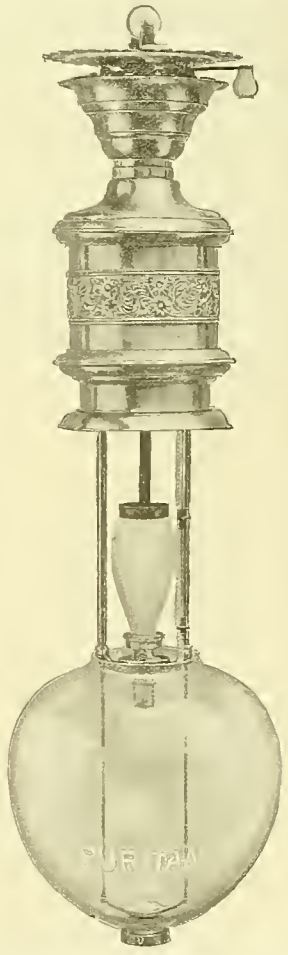
Puritan Alternating Current Arc Lamp.

In the illustration is shown, in position for trimming, the new alternating current arc lamp of the Puritan Electric company of 150 Nassau street, New York. The lamp is designed to burn 100 hours without retrimming on alternating current circuits. Ready for burning it is only 33 inches long and is compact and handsome. The arc is enclosed. All of the mechanism is very simple. Cored carbons 7½ inches by one-half inch are used, and give a pleasant, steady and uniformly distributed light, when burning on circuits from 100 to 120 volts and from 7,000 to 16,000 alternations. This is wide enough range for all the practical alternating work of the day. A noteworthy feature is the quietness of the Puritan lamp. Induced by its success with the alternating form, the Puritan company is now introducing also a type to burn on continuous current circuits, needing only a slight manipulation of the resistance and nothing else. It is also being put on the market for regular series arc work, at 6.8 and 9.6 amperes respectively, so that the lamp covers virtually the entire field of the arc and lays broad claim to universality.

Keystone Switchboard Instruments.

From the Keystone Electrical Instrument company, Ninth street and Montgomery avenue, Philadelphia, comes a well written description of its instruments. The style is easy and conversational, and the exact language is quoted:

Our line is not very extensive, but it is essential to



PURITAN ALTERNATING CURRENT ARC LAMP.

every well-equipped central station or isolated plant, whether used for lighting or power purposes. We have spent a number of years learning the needs and requirements of our customers, and have done our best to fully meet them. We believe we have succeeded, and, if we are mistaken, will be glad to have you tell us so.

Our switchboard instruments are not like any other make of instruments, either inside or outside, and represent the results of a careful analysis of every system

which has ever been offered to the public, with a view to eliminating all existing defects and the incorporation of all needed improvements. We have a confidence in our product which is beautiful to behold, and one of our prime objects is to inspire a similar confidence throughout the trade. We believe we can do this if given the opportunity, for if our inspector is satisfied you will be.

We claim just a few points of merit in connection with our instruments, among which we may mention that they are absolutely correct in calibration when we ship; the reason they are correct is that we have as complete a laboratory equipment as time, money and experience can gather together. You will find there all the delicate machinery, calibrating devices and standards needed. Our standards are absolute and kept in check with fundamental units, and since our system contains nothing subject to change or deterioration they remain correct so long as they are properly handled.

Workmanship and material are of the best; cases are dust proof, bearings jeweled, pointers dead-beat; moving parts are shielded from the effects of external magnetism, and ranges anything you may want. There are lots of other good points about our instruments. Price is one; but we prefer to tell you about them in our literature and by correspondence and to surprise you with them if you buy.

The cuts presented herewith illustrate four of our principal types.

Fig. 1 shows our type "K illuminated dial" instrument and Fig. 2 our type "K." Both of these instruments are handsomely finished in brass, grained by hand and lacquered. They are made in all ranges, both volt and ammeters, and are combination instruments; that is, will read with equal accuracy on either direct current circuits or alternating current circuits of any frequency. We believe we are the first to put such a switchboard instrument on the market. The only difference between the two lines, as shown in Figs. 1 and 2, is that the first has an illuminated dial while the second has not.

Fig. 3 shows our type "R" instrument. The system is similar to our type "K," but the case is smaller and is made of iron, the body being finished in black japan while the front is full nickel. We make our type "R" instruments with combination systems, the same as type "K," or without. The latter is cheaper and very satisfactory when an instrument is wanted on one circuit only. We calibrate them for direct current or for alternating current of any specified frequency.

Fig. 4 shows our galvanometer ground detector mounted in brass case grained and lacquered. This instrument is very useful in showing the extent of grounds and in indicating on which side of the line they are. It is intended to be left in circuit continually; good for either direct or alternating current, as desired.

We also manufacture differential voltmeters mounted in type "K" cases with or without illuminated dial These instruments are very useful when two or more direct current dynamos are run from the same set of busbars. We could say a great deal more on the subject, but we do not own the entire issue. If you write us we will tell you the rest, treat you well and serve you promptly. Some day soon we will give you a few lines on portable instruments. We are not perfectly satisfied with them yet, but when we are will tell you all about them.

Speed of Electrical Impulses Over Iron Wire.

W. J. Camp of Montreal writes to the *Telegraph Age* to assert that the speed of the electric impulse is very much less than is generally supposed. He says:

By actual experiment in Canada, between distant points, over No. 6 B. W. G. iron wire, without repeaters interposed, it was found that the speed was about $\frac{8}{100}$ of a second per 1,000 miles, or 33,000 miles per second.

I might mention an experiment I tried last August. I made up a telegraph circuit from Montreal to Montreal (duplexed), with repeaters, as follows:

Montreal	0 miles.
Sudbury	443 "
Fort William	998 "
Winnipeg	1,425 "
Swift Current	1,937 "
Donald	2,450 "
Vancouver	2,909 "
Portland	3,277 "
San Francisco	3,995 "
Albuquerque	5,195 "
Kansas City	6,011 "
Chicago	6,673 "
Toronto	7,315 "
Montreal	7,655 "

At McGill College, Montreal, a chronograph was connected and signals sent around the circuit, these signals being recorded when starting and also on completing the circuit. The average time occupied was .52 of a second for the 7,655 miles. I then connected the receiving side of one end to the sending side of the same end, so that a signal would be repeated back on the opposite side of the duplex, making a total circuit of 15,310 miles. The average time to complete the double circuit was 1.06 seconds.

Allowing $\frac{8}{100}$ of a second for each of the 26 repeaters, this would make the speed only about 28,600 per second, in the second case, and about 29,400 in the first. The repeaters, of course, had to be estimated according to other tests, and the probability is that some of them occupied more time than others. Some of the repeaters were not well adjusted, as it was difficult to get the signals around the doubled circuit, a dash being reduced to a dot.

On a previous occasion, the same circuit was arranged so that one end repeated into the other, and a signal started in one direction traversed the circuit eight times before it stopped. On another occasion, a duplex circuit between Montreal and Vancouver, 2,909 miles, was connected at both ends, so that a signal went backward and forward for over 200 times, and then only stopped on account of someone interrupting the circuit.

Shadow of the National School of Electricity.

The disadvantage of undesirable business associations is generally recognized, but the result of an unfortunate connection with one who is generally regarded with distrust by his neighbors is not always understood. It is true, unfortunately, that in many cases innocent victims are the greatest sufferers, while the chief offender, oblivious to public contempt and indignation, goes unscathed. This condition of affairs is strikingly exemplified in the history of the late National School of Electricity, of inglorous memory. The record of the defunct institution hangs over every man who was connected with it and casts a shadow upon his reputation. The eminent character of the men who comprised the faculty could not save the institution when the public realized that the business end of the enterprise was being conducted by men whose methods had come under suspicion. This baleful influence at length proved the destruction of the project. In view of these facts and taking into consideration the manner in which the affairs of the school were settled, it is not at all strange that members of the faculty disclaim responsibility for the business management. When the end came much indignation was expressed by all engaged in the work, pupils and instructors joining in the general condemnation of the management. An idea of the sentiment that prevailed can be gathered from the following expression of the Denver class:

WHEREAS, The National School of Electricity, a Chicago corporation with classes throughout the United States, organized in May, 1895, a class in Denver, Col., with a membership of about 100, most of whom paid the full tuition fee of $20, and the remainder a portion of this fee; and,

WHEREAS, The school failed to pay the instructor of the class as agreed, but induced him to continue the lessons for many months by false promises of payment, and finally ignored his correspondence altogether, thus causing a discontinuance of the course before completion, and,

WHEREAS, We are informed that this school has sold its apparatus and appliances to an organization known as the Chicago School of Electricity, but that the latter has not assumed the former's liabilities, and it therefore appears to be impossible to enforce our claims against the National School; ·

Resolved, That we, the Denver class of the National School of Electricity, condemn that institution for its unbusinesslike and dishonest actions, and warn the electrical public against having any dealings with it, or the individuals associated therewith: and in order to give the matter proper publicity, which we believe to be our duty, the secretary is hereby instructed to send a copy of this resolution to each of the leading electrical papers.

It should be explained in justice to Mr. Bagnell, the manager of the Chicago School of Electricity, that his enterprise is not conducted upon the same lines as its predecessor, and that it is not controlled by the same element. Mr. Bagnell is emphatic in his assurance that neither J. Allan Hornsby nor any other member of the management of the old school is in any way connected with the new school. As conducted by the present management the Chicago school is, in our opinion, a legitimate educational institution, and moreover it is doing much good work. When Mr. Bagnell purchased the apparatus, etc., of the National school, he found that he had also assumed a load in the form of a well defined public prejudice against a school of that kind. This he has been endeavoring to overcome, but occasionally the shadow of the National school falls upon its successor. Only recently the following communication was sent to the WESTERN ELECTRICIAN and the other electrical papers by Dr. Perrine of Leland Stanford Junior University:

My attention has been called to the fact that the Chicago School of Electricity is making use of my name in their advertisements. Such a use is altogether unauthorized. The work I did for the National School of Electricity on their "lesson leaves" was supposed to be for their classes entirely and was of the nature of a review of some of Prof. Jackson's writings. I have no connection with the Chicago School of Electricity and consider that their use of my name is of the nature of a breach of faith on the part of the managers of the National School of Electricity.

We can readily understand how Dr. Perrine dreads all mention of his name in connection with the National School, and we can appreciate his desire to disclaim all connection with that institution since the failure of the school to fulfill its obligations to the San Francisco class. but in protecting himself it is claimed by Mr. Bagcell that Dr. Perrine has unintentionally done him a grave injustice. Furthermore, it appears from the following comment of an eastern electrical paper upon Dr. Perrine's letter that an erroneous impression prevails in New York upon the character of the new Chicago school:

The original founders [John P. Barrett and J. Allan Hornsby] of the National School of Electricity have so repeatedly demonstrated by dishonorable acts their total moral irresponsibility that we are not surprised at anything they do. The Chicago School of Electricity is the successor of the National School, we believe, and under the direct management of the founders of the former.

Mr. Bagnell explains his position and the relation of his school in the following communication:

Will you kindly state in your valuable journal that we have not used or are not using his name in our advertisements, and that we do not purpose so to advertise, as Dr. Perrine has no connection with the Chicago School of Electricity whatsoever.

The lesson leaves, which were prepared for the National School of Electricity have come into our control by purchase, and we have published them in book form, giving the names of the authors, and stating "published by the Chicago School of Electricity." Dr. Perrine admits in his letter to you that he did assist in preparing the lessons—the only thing we have stated in our advertisements.

No one who was financially interested in the "National School of Electricity" is in any way connected with the Chicago School of Electricity.

This incident further illustrates the evils growing out of association with such men as those who controlled the affairs of the National School of Electricity. The shadow of that institution cannot fail to harm all upon whom it may fall.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 9.—At a special meeting of the officers and committee of the Electrical Sound Money Club, held at the offices of the treasurer, Capt. W. L. Candee, 253 Broadway, yesterday, it was voted that in view of the fact that the objects for which the club was formed had been successfully accomplished, the club be dissolved. It was also voted that the treasurer be directed to donate to some charitable object the small balance of cash on hand. Those present at the meeting were: Dr. S. S. Wheeler of the Crocker-Wheeler Electric company, chairman; Capt. W. L. Candee of the Okonite company, treasurer; Vice-presidents J. E. Ham, with W. R. Brixey, and Charles Blizard of the Electric Storage Battery company; Gen. C. H. Barney of the New York Telephone company, chief marshal; A. C. Shaw of the *Electrical Engineer*, and Stephen L. Coles of the *Electrical Review*, secretary. Resolutions of thanks were passed for favors extended by various corporations, and a special vote of thanks was tendered to General Barney for the excellent work he did in organizing and commanding the 1,832 men turned out in the business men's parade by the Electrical Sound Money Club.

John Jacob Astor, who is personally much interested in electrical matters, has awarded the contract for the electrical equipment for the New Waldorf Hotel, on Fifth avenue, between Thirty-third and Thirty-fourth streets, to the Walker company of Cleveland. This plant will be notable as the largest isolated incandescent lighting plant in the country and will be sumptuously fitted up as a show feature of the hotel. It will have a capacity of 25,000 lights, thus surpassing the 17,000 of the Auditorium in Chicago. The engine room will be beautified with onyx and marble, and a balcony for guests will run around the upper portion of it. There are to be six dynamos, four of them of 250 kilowatts capacity and two of 100 kilowatts capacity. The larger generators are to be operated at the unusally low speed of 90 revolutions per minute and the other two at 100 revolutions per minute. If these machines were wound to deliver their output when run at a speed which would be considered the maximum safe working speed, they would be capable of supplying 50,000 lights. This slow speed was adopted because it reduces the vibration of the machine and increases its life, and also because this speed enables the direct connection of the dynamo to a Corliss engine. High speed engines are used in all direct-connected isolated plants, and the proposed Waldorf Hotel plant is probably the first of its kind in this respect. The engines are to be of the Allis-Corliss type, direct-connected to the Walker generators. The machines are to be multipolar, the field frame being of cast iron, while the pole pieces are of laminated wrought iron supplemented with a steel pole shoe. The machines

are to be especially well finished. All brass parts are to be buffed, polished and lacquered, and the bodies of the machines are to be filled, smoothly enameled and elaborately decorated.

Some time ago Arthur S. Higgins, a glass importer on Twenty-second street, requested the police to arrest the night watchman of the building containing his office on suspicion of stealing money which Mr. Higgins had missed from his desk. The desk was not tampered with, and it was evident that the thief had a key. The detectives investigated the character of the night watchman, and found it to be above reproach. Then they set a trap to catch the thief. They set up an electric alarm extending from the desk to a room on the second floor of the building at No. 58 West Twenty-second street, and in the room they had placed Howard Watkinson and Charles Tannenbaum, two employes of Mr. Higgins, with instructions to rush to the street the minute they heard the alarm go off. Then the detectives took up their stand in the doorway opposite the building and awaited developments. In the meantime Mr. Higgins had placed in the desk three ten-dollar bills, two two-dollar bills and one one dollar bill, all of which were marked. About 7 o'clock on the morning of January 3d the detectives in hiding saw Prince Read, the colored janitor, go to the front door of No. 50 West Twenty-second street. This he unlocked with a key; then the detectives saw him ascend to the second floor. After half an hour Read came out of the place, and at the same time Watkinson and Tannenbaum dashed out of the hallway of No. 58 shouting, "The alarm's gone off." The detectives arrested Read, and as they did so he attempted to drop two ten-dollar bills he had in his hand. The money was picked up and he was told that he was charged with stealing it. At first he declared that the money was his, but when he found it was marked he changed his story, and said that he had found the money on the floor. Read, who is 50 years old and had previously borne a good reputation, was held in $1,000 bail for trial. W. F. O.

Washington, D. C.

WASHINGTON, January 9.—The United States Electric Light company and the Potomac Heat & Power company, rival companies, had a hearing before the Senate district sub-committee during the week, which lasted two hours. Nothing definite resulted from the hearing. There are several resolutions up before the committee bearing upon this topic, but nothing has as yet been definitely decided in regard to them. There is every prospect, however, of a long and bitter fight, as each side is determined to do all in its power to defeat the other.

Congressman John J. Gardner of New Jersey, accompanied by Andrew P. Tallmadge and Henry C. Wilson, two Washington electricians, have gone to the former's farm near Egg Harbor City. They intend to establish an electric plant to furnish power for lighting, pumping, wood sawing, feed cutting, thrashing, etc. One of the features of the equipment will be a portable truck motor. Mr. Gardner, in connection with his large berry farm, operates an extensive canning plant, so that this electrical power will also contribute to the economical working of that branch of the business.

While it is not known with whom the matter originated, it is known that the district commissioners have been requested to increase the speed of the street cars to 12 miles per hour. Accordingly the commissioners have addressed communications to the presidents of the companies asking if they have any objections to the increase. The hearing that will follow will be a lively one, as was the last one when the speed was increased from nine to 10 miles per hour. T. I. P.

Northwestern Notations.

MINNEAPOLIS, January 9.—The council of Morris, Minn., is considering an application for an electric light franchise from Mr. Fowler.

The city councilors of Tacoma, Wash., are considering placing the electric light service on the meter plan in order to increase receipts or decrease consumption. They find that people will substitute 32 candle power lamps for the 16 candle power globes the city puts in, and thus get twice the service they pay for.

Mr. Hackl's electric light plant is ready for operation at Lodi, Wis.

J. J. Dunn has purchased the electric light plant at Dyersville, Iowa, of A. M. Searles.

Stockholders of the Washburn (Wis.) Electric Light & Power company have applied to the court to ascertain the standing of the company and find out how the business is run. They claim that they have been unable to get any satisfactory statement of the condition of the concern.

Emerson, Neb., will have an electric light plant if 150 lights are subscribed for. Already 135 have been taken.

Henry Leibole has been granted a franchise for electric lighting at Thorp, Wis., and will have work begun on the plant soon.

Elkader, Iowa, wants electric lighting.

The injunction case to prevent the city of Negaunee, Mich., from putting in an electric light plant has been decided in favor of the city, but it is thought the contractors will not begin work until spring.

City authorities of Red Wing, Minn., regard the lighting rates the city has to pay as exorbitant and contemplate putting in a municipal plant.

The electric light plant at Fairmont, Minn., owned by the village, was burned with a loss of $3,000; fully insured.

The Electric Light & Fuel company of Rawlins, Wyo., contemplates removing its plant to the company's coal mines 3½ miles southwest of the city, where it is believed the plant can be operated cheaper and can furnish power to operated the mine machinery.

Alex. Hughes of Bismarck, N. D., contemplates putting in an electric light plant at Valley City, N. D.

Mayor McVicar has received plans and specifications from Engineer Frank B. Rae of Chicago for the proposed municipal electric plant for Des Moines, Iowa. C.

Milwaukee, Wis.

MILWAUKEE, January 9.—In the Circuit Court the Milwaukee, Racine & Kenosha Electric Railroad company has won a decisive victory over the Chicago & Northwestern Railroad company, which sought to prevent the electric line from making a grade crossing where the two roads meet at South Milwaukee. Counsel for the Northwestern read the articles of incorporation of the electric railway company, which give it the right to haul freight as well as passengers, and contended that the electric line was properly a regular railroad and could not obtain a right of way except by purchase or by exercising the right of eminent domain. The electric company claimed the right to pass over the Northwestern tracks by means of a grade crossing, because at that point the Northwestern road intersected a public highway, which the public had a right to use and over which the electric railway people had obtained a franchise. A street railway, it was argued, was only a means of facilitating the use by the public of the highway over which such a line runs. Judge Johnson took this view of the matter, held that it was within the power of the Legislature to authorize a street railway company to carry freight as well as passengers, and dismissed the injunction restraining the electric railway people from building a crossing at the point in dispute. A day or two before this decision was rendered the new electric line between Milwaukee and Racine was opened to public travel. In the first car that went through from Milwaukee to Racine were a number of representatives of the press and officers of the Milwaukee Electric Railway & Lighting company and the Milwaukee, Racine & Kenosha Electric Railway company. The Racine road extends only to South Milwaukee, where it connects with the Milwaukee line, but through cars are run between the two cities. It takes about two hours to go from Milwaukee to Racine over the new line, the trip from Milwaukee to South Milwaukee occupying quite as much time as the longer distance from South Milwaukee to Racine. The Racine does not expect very much patronage this winter, but next summer, it is thought, there will be a very large excursion business. It is by far the longest electric line in Wisconsin. Next season, in all probability, it will be extended to Kenosha.

Congressman William Alden Smith of Grand Rapids, Mich., has been in the city within the past few days for the purpose of looking after the interests of prospective purchasers of bonds which the Milwaukee Waukesha Electric Railway company proposes to issue. He represents New York and Boston capitalists to whom the bonds have been presented for investment. The amount of the bonds, he said, was $7,000,000, and while he would not anticipate his report, he said intimated that it would be favorable. That the company contemplated such a large issue of bonds, and seemed likely to dispose of them, caused no little surprise in this city, where there has always been more or less skepticism as to the company's ability to carry out its plans. Ex-President McDonald now comes forward with a statement that his retirement from the management of the company was due to Milwaukee men signing the bond which the company deposited with the city. It was deemed desirable, according to McDonald, for the company to be headed by Milwaukee men. Next spring, he stated, the work of building would be begun, and there would be plenty of money for the purpose. If his statement is correct, he will again become president of the company if he desires the position. He said that he was still in actual control of the road. "No matter what reports you hear to the contrary," he said in conclusion, "the line will be built next year."

Milwaukee city officials have been contemplating a state convention of the men in charge of the street departments of the various cities in the state for the purpose of bringing influence to bear upon the Legislature for the repeal of the law providing that street railway companies of the state shall pay into the public coffers a certain percentage of their earnings, according to the amount thereof, in lieu of taxes. The idea of holding a convention was finally abandoned, however, some of the city officials fearing that the street railway people might try to get control of the convention—a contingency that would be a severe blow to the opposition. The decision which was finally reached was to appoint a committee of the anti-street railway aldermen of Milwaukee to watch the course of legislation in Madison and to see that the proposed new bill for the taxation of street railway companies was not put off until the last moment and then loaded with amendments which would serve the purpose of the street railway companies almost or quite as well as the present law does.

In the four-cent fare case, which is pending in the United States court, the Central Trust company of New York and the Milwaukee Electric Railway & Lighting company have been given three months in which to take testimony showing that the four-cent fare ordinance is unreasonable and therefore void. The city has been given three months to take testimony in support of its measure, and after it is finished the complainants will have six weeks in which to gather evidence in rebuttal. William Nelson Cromwell, the president of the street railway company, said that during the time when the old company, which had bought the different lines, was engaged in equipping them with electricity, the system was unremunerative, the company finally going into bankruptcy. Then came the sale of the road and the reorganization, the capital stock being reduced from $12,000,000 to $7,000,000, and even to-day, Mr. Cromwell said, the stockholders were not receiving one penny upon their holdings. For the last 11 months, he said, the earnings had been just enough to pay the expenses of operation and the interest accruing. Under a four-cent fare system the inevitable result to the company would be bankruptcy. Assistant City Attorney Van Wyck argued that even under a law which required the company to sell 25 tickets for $1, fully 50 per cent. of the people who boarded cars would pay five cents every time that they rode, while many of those who did buy tickets would purchase them in smaller quantities, which would give the company 4½ cents for each passenger of this kind. Furthermore, if commutation tickets were sold, more people would ride, on account of the cheap fares, so that in the end the company would not be a loser, and might be a gainer. Judge Seaman, however, ruled that the showing of probable loss made by the street railway people was sufficient to justify the continuance of the injunction against the city, without his going into the merits of the case, and he issued the order to take testimony, giving each party the privilege of naming its own commissioner in each city. The low-fare fight in Milwaukee will now be aired in nearly all the cities of the land.

The Milwaukee Electric Railway & Lighting company has decided to abandon the old Badger lighting plant on Commerce street. The machinery at that point will be removed to a new building, brick and stone, four stories high, which will be erected next to the Edison power house on River street. The new building will be used almost entirely for arc lighting. Eventually the Pabst power house on Broadway will also be merged into the River street plant. C.

Through the medium of the daily press the public is now made aware of the important fact that Fannie Davenport carries with her a "personal electrician," whose duty it is to fix lights and mirrors in her dressing-room so that she can see exactly how her magnificent attire looks from every point of view.

PERSONAL.

The Russian Academy has elected as honorary members Lord Kelvin and Dr. Simon Newcomb of Washington.

R. L. Weithas, long in charge of the composition on the *Electrical World*, has accepted a position with Howard Lockwood & Co. of New York to take charge of one of their large departments. The many friends of Mr. Weithas in the electrical trade will be pleased to hear of his success.

James Kirk of Piqua, O., who strung the first telegraph line between Baltimore and Washington, in 1844, has been stricken with paralysis, and is in a critical condition. In the early days of telegraph construction he was prominently identified with several companies. He was a broker in New York city for many years.

ELECTRIC LIGHTING.

The Chicago City Railway company has sent City Comptroller Wetherell a check for $10,000 in settlement of its percentage required for the maintenance of the electric lights along the South Side streets traversed by the cars of the company.

ELECTRIC RAILWAYS.

A suit has been brought by all the unions composing the Central Labor Union against the Louisville (Ky.) Street Railway company and the General Council of the city, asking for a prohibitory injunction to restrain the company from operating the road, and for a mandatory injunction to compel the General Council to repeal the ordinances granting the franchises to the company. The grounds alleged are that the ordinances granting the franchises were illegally obtained; that the streets are obstructed by poles, wires, cars, tracks, mules, etc.; that no vestibules are provided for the motormen in cold weather; that no conductors are furnished, and that the fare should be reduced to two cents. It is alleged that the General Council has failed and refused to repeal the charter of the company, and the court is asked to compel that body to act. The company controls all the street car lines of the city.

Mr. Moloney, attorney-general of the state of Illinois, has begun proceedings against the Chicago Electric Street Railway company, the new company whose proposals for North Side traffic were noticed in the WESTERN ELECTRICIAN of January 2d. The attorney-general filed an information in the Superior Court for a quo-warranto writ to compel the company to show by what authority it is at work securing frontage consents from property owners along the proposed route. The information alleges that Sherman D. Purnea, John Parrott and O. W. Larson organized the company in 1895 and in June of that year procured articles of incorporation under the name of the Chicago Electric Street Railway company. The capital stock was made $5,000,000, and the attorney-general says that Lucius Clark, C. L. Stinson and George Pegerfl pretended to subscribe for the stock. The whole proceeding, it is alleged, was a pretense, and merely colorable.

On January 4th the "Hilltop" road was opened in Pittsburg, Pa. This line is a branch of the Pittsburg & Birmingham Traction company's system which connects the old city of Pittsburg with those districts situated on the southern shore of the Monongahela River. The Hilltop line runs across the Monongahela over the Smithfield street bridge and goes up Brownsville avenue, with a grade of 15 per cent. By this road the suburb of Knoxville is reached. The line has been in great demand because it will afford rapid transit facilities to about 50,000 people who have hitherto been entirely dependent upon inclines and such walking accommodations as unpaved streets afforded. The Birmingham Traction company operates 22 cars on the Hilltop line. The cars are equipped with two 50 horse power Westinghouse motors and controllers. To take care of the increased traffic occasioned by the opening of this line, the company has recently remodeled and re-equipped its power house at Thirty-first and Carson streets. This power house was equipped with generators of an older make. Three 700 kilowatt Westinghouse generators have been substituted.

TELEPHONE.

H. L. Savarien has opened a telephone exchange at New Ulm, Minn.

Dr. W. L. Winnard, an enterprising young physician who lives in Warsaw, Ill., has adopted an original method for extending and improving his practice. He has built a private telephone line, connecting several near-by towns with his office, which keeps him in constant touch with his patients in the country. The line is entirely free for the use of his patients. It is constructed in the best manner, and the most modern instruments are used. Six towns have been reached and 35 miles of line have been constructed. Dr. Winnard says he will extend the system to as many more points as soon as work can be resumed in the spring. The telephones are located in the principal store in each place and are cared for by the proprietor, who is glad to do so for the use of the line for his own business.

The Western Electric Telephone system is shown in the blue print of the lines in Iowa, Minnesota, Wisconsin and South Dakota, just issued by the company. It has completed the toll line from Britt, Ia., where the general offices of the company are located, to Forest City, connecting Crystal Lake and Hayfield. A line has recently been constructed by this company and is now in operation from Sioux Falls to Garretson, S. D., and the poles are set for a new line from Luverne to Pipestone, Minn., and several new stations will be opened up on the line in that vicinity during the present month. The Western Electric Telephone system is a consolidation of the lines of the Western Electric Telephone company and the Union Electric Telephone company, with headquarters at Britt, Ia. The companies own and operate almost 2,000 miles of toll line, connecting 183 cities, towns and villages in the four states named. This is said to be the largest independent toll-line telephone company in the United States.

ELECTRIC MINING.

J. M. Householder, a crippled coal miner of West Elizabeth, Pa., who has been confined to his home for a number of years, has invented an electric coal cutter with novel features. The machine cuts the coal with saws fastened to an endless chain which runs around a wheel on a swinging arm, and is controlled by the operator. There are three different positions in which the machine can be placed, and the work it is to do is easily understood by the miner. Two men are required to run each machine, one for the cutter and the other for the drill, and it is stated that they can make 2,000 bushels of coal ready for the shovelers in 10 hours. They undermine, cut the ends and drill the holes ready for shooting it down. The machine leaves the bottom smooth, making it much easier for the loader. It can be arranged to cut any depth desired, and the coal cut out by undermining is only one-fourth cut into dust, the other three-fourths being nut coal. The apparatus is mounted on a truck and can be worked in a space four feet wide.

MISCELLANEOUS.

"Conventional Diagrams of Electrical Apparatus," was the subject announced for a lecture by D. W. C. Tanner, before the Chicago Electrical Society for January 15th.

The Electrical Mechanics of Chicago have elected officers as follows: President, H. C. Horstman; vice-president, Charles Osberg; recording secretary, E. H. Williams; financial secretary, George Kaufman; treasurer, William T. Moffit; inside guard, John Gill; sergeant-at-arms, J. J. Dolan; statistician, Victor Paulsen; business agent, Charles B. Quealy; board of examiners, C. B. Quealy, J. D. Warren, J. W. Cronk, F. N. Clark, Herman Modine; trustees, Frank Gardner, J. W. Quealy, Samuel Grimblot, Thomas Crowley, R. H. Maxwell.

This curious story comes from Muncie, Ind., dated January 8th: Last evening Ralph and Lloyd Martin, twin brothers, aged 10, were sent by their mother to deliver some washing which she had done. They kept the money and went to the theater. Being afraid to go home they stole into the electric plant of the Heat, Light & Power company, and crawling up to a steam pipe slept there all night. This morning N. Heffner, the engineer, discovered them sound asleep, and, thinking to have a little fun by frightening them, uncoupled the pipe and turned the steam on. The boys were horribly burned about the body and lower limbs. The flesh peels off and both may die. Heffner is nearly crazed with the result of his little joke.

An excellent publication which bears evidence of prosperity is the eighteenth annual number of the *Tradesman*, published at Chattanooga, Tenn. It contains over 260 pages, and presents a complete, exhaustive and valuable review of the South, its resources, development and possibilities. The special articles are from leading thinkers, statisticians and business men. Among its contributors are six southern governors, the chief statistician of the United States census bureau, 12 journalists, 20 chamber of commerce officials, such writers as Edward Atkinson and a score or more of statistical writers and industrial authorities in their special lines of national and international reputation. One of the many features is a complete directory of 5,000 of the leading industrial plants of the southern states.

TRADE NEWS.

The works of the Consolidated Insulated Tube company, located at Lynn, Mass., were destroyed by fire on January 3d. The company has already made preparations for rebuilding the factory.

"Doc" Edgar of the Dearborn Laboratory, Rialto building, Chicago, has devised a set of cards picturing the results of using Dearborn boiler compounds. The pictures tell their own story very clearly; the leading types of boilers are all represented as in ecstacy after being cleaned out by "the Dearborn."

Very flattering reports are received from those who have had experience in using the Gardner die head which was illustrated in the last issue of the WESTERN ELECTRICIAN. Charles H. Besley & Co. of 10 Canal street, Chicago, who manufacture this device, are well pleased with the reception accorded it by the trade.

The Mica Insulator company of New York, Chicago and London, announces that it has removed its western headquarters to 117-119 Lake street, Chicago, and is in a position to fill all orders for Micanite specialties promptly. During the last year the company has enjoyed an increased trade in the West among the electrical manufacturers, electric railways and lighting companies.

The Ferracute Machine company of Bridgeton, N. J., has never been so pressed to keep up with its orders as at present, and General Manager Fred Smith reports that night and day work has been the rule for the last two months. The company has large orders for stamping machinery from Budapest and the government of China, beside increased business in this country over last year.

The Bibber-White company of 49 Federal street, Boston, has succeeded to the business of Bibber, White & Co. and the New England Electric Supply company, and will carry a full and complete line of everything needed by the electrical and kindred interests. The company promises the largest stock in the East, can make immediate shipments, and will be pleased to make quotations.

The I-T-E automatic magnetic circuit breaker is very clearly shown in colors and low relief, on the fine calendar of the Cutter Electrical & Manufacturing company of 1112 Sansom street, Philadelphia. A large edition of the calendar has been prepared for distribution among the electrical fraternity, to call attention to the fact that this circuit breaker is simple in construction and to the claim that "it is as perfect electrically as it is mechanically accurate and artistically beautiful."

Charles Blizard, manager of the New York office of the Electric Storage Battery company of Philadelphia, has a large amount of prospective business on hand and reports the outlook exceedingly bright. Although a large business was done in 1896 over that of the previous year, the present one promises to show a like increase over the last year. Mr. Blizard has been identified with the Electric Storage Battery company for several years, and is widely and favorably known in the electrical trade.

Vallee Bros. & Co. of Philadelphia, Pa., have recently located in new quarters at No. 625 Arch street, which have been specially fitted up for their business, and have a depth of 170 feet and a width of 32 feet. Business and private offices have been placed near the rear of the store, while the front and basement are occupied with a stock which it would seem could fill the wants of anyone in the electrical line in Philadelphia. It was only a few years ago that Vallee Bros. started in a very modest way, and by push and square dealing their present success was attained.

In a suit brought in the United States Circuit Court of Maryland by A. G. Davis against the Chesapeake & Potomac Telephone company for infringement of patent No. 223,968 granted to J. H. C. Watts, the court has rendered a decision in favor of the plaintiff and holds that the switchboard pin used by the Chesapeake & Potomac Telephone company in its exchanges in Baltimore and Washington, D. C., is an infringement on Watts' patent. This is said to be a victory for the Viaduct Manufacturing company of Baltimore against the Western Electric company.

The Mansfield (O.) Tempered Copper company makes fine brass and copper castings for electrical purposes. The company directs especial attention to its commutator bars and makes a liberal proposition in cutting slots free of charge. Of its tempered copper castings for this purpose the company says: "For density and purity they cannot be excelled. We use nothing but pure ingot copper of the highest grade, and guarantee every bar to be true to gauge, and solid throughout. Our process of tempering is new, and is so perfect in results that blow-holes or imperfections of any kind below the surface cannot exist, no matter what the shape of the casting may be."

Possibly the friends of A. C. Bunce and W. E. Donley will be surprised to learn that they have formed a partnership, and will do business hereafter under the firm name of Donley & Bunce, with offices at 1141 Monadnock building, Chicago. The reputation of these two gentlemen as popular and successful salesmen has already secured them a number of excellent connections, as, for instance, the Westinghouse Glass factory, the Sawyer-Man Electric company, Chicago Insulated Wire company, Western Gear company, Turner Brass company, Diamond Electric company, while others are in prospect. Donley & Bunce ought to make a combination hard to beat, and their orders thus far seem to indicate a successful business career.

For a firm of such ripeness of years, the Jewell Belting company of Hartford, Conn., has a large amount of juvenile sprightliness left, and in fact it would seem that age rather added to its pushing abilities. After the fire of the Newark Electric Light & Power company, at which all of the apparatus was destroyed, a telephone order was sent after midnight to the Jewell Belting company for belting which weighed two tons, provided it could be delivered at Newark not later than five o'clock on that day. Under the direction of Treasurer C. E. Newton, at 10 o'clock the belting of various sizes was on its way to New York, where it was received by C. A. Ainsworth, manager of the New York office of the Jewell Belting company, and by teams taken to Newark, where it was delivered on time, much to the satisfaction of the purchasers.

Paint is a material that must be used by electrical companies as well as by others, and Dixon's silica-graphite paint is recommended for metal or woodwork, telegraph and trolley poles, smokestacks, boiler fronts and iron construction work of buildings. Its durability is one of its chief advantages. In a recent pamphlet the Joseph Dixon Crucible company of Jersey City states that the Consolidated Traction company of New Jersey has long been a user of Dixon's silica-graphite paint. At one time it painted one of its immense carstable roofs with this paint, and another one with a metallic paint that is largely advertised, and awaited re-

sults. The directors of the company finally decided unanimously that Dixon's silica-graphite paint is by all odds not only the best but the cheapest paint, and that hereafter it should be used entirely for all their roofs and the iron work of their other buildings.

BUSINESS.

The Metropolitan Electric company of Chicago reports large sales of of telephone supplies, of which it carries a full line.

Eugene Munsell & Co., miners and importers of mica, Chicago, announce that they have moved into their new quarters at 117-119 Lake street. The increased facilities for handling western business will enable them to carry a larger stock of mica and drop forged copper segments, and thus place them in a position to fill all orders promptly.

J. H. Astruck, representing the Electric Arc Light company of New York, has just returned from a western trip, and reports having closed some large contracts for "Pioneer" enclosed arc lamps. He found a somewhat improved tone among the dealers in some sections and is encouraged to expect a good finish to a very prosperous season for the "Pioneer." The New York shoe house of Cammeyer & Co. decided in favor of the "Pioneer" enclosed arc lamp for its entire new building, Sixth avenue and Twentieth street.

Notwithstanding the advance in the selling price of the standard makes of lamps, explained by the statement that the manufacturers have been operating under an actual loss for the last two years, the Electric Appliance company reports that the sales of Packard lamps have increased since the time of the advance, showing that its customers appreciate a good thing, and are willing to pay a fair price for a first-class article. The Packard lamp business has always been a very satisfactory part of the Electric Appliance company's trade.

H. McL. Harding, general sales agent for the Walker company, is receiving congratulations upon the announcement that John Jacob Astor has just concluded a contract with the Walker company for an electric plant for the New Waldorf hotel on Fifth avenue, New York. The apparatus in the present Waldorf will be taken out and a new plant installed suitable for doing everything necessary in the enlarged hotel, which will be more than double its present size. The Waldorf system will be one of the largest isolated plants in the world, it is said.

Morris, Tasker & Co. of Philadelphia report that the past year has shown much better results than was anticipated in their trade. This concern has made a specialty of wrought iron and steel tubular poles which are in use in England, Egypt, Africa and Australia. In America of course the poles are seen in all leading cities. To no one, probably, is due more credit for the push and vim shown in placing this company so well in the lead in this line of business than to Secretary H. C. Vansant. Although this company is old in years, being established in 1821, it was never more vigorous than at present.

The following is the list of machinery shipped by the American Engine company, Bound Brook, N. J., during the month of December, 1896: Sixty horse power American-Ball engine to the Scranton *Truth;* 50 horse power and 12 horse power motors to the Western Newspaper Union; 100 light dynamo to the *Chattanooga Daily News;* 60 horse power American-Ball engine to the *Albany Journal;* five horse power motor to the Gazette Publishing company; 12 horse power motor to the *Toledo Blade;* 12 horse power motor to the W. D. Boyce company; nine kilowatt dynamo to the *Age-Herald* Publishing company; nine kilowatt dynamo to the Dayton *Journal;* three horse power motor to the Indianapolis *Sun;* 75 kilowatt dynamo to the *Inquirer* company; three horse power motor to the *Harrisburg Telegram;* nine kilowatt dynamo to the Jarecki Manufacturing company; 100 horse power motor to the *Boston Herald.*

The vertical engines being built by the Ball Engine company for electrical service have been received with great favor by those who appreciate merit and good workmanship in an engine. Since October 1st last the works have been running till 10 o'clock every night and part of the time all night, on account of several large contracts received for vertical engines. Some of these orders are just being completed. Among them is a 400 horse power vertical cross-compound engine arranged for direct connection to a 225 kilowatt Siemens & Halske generator, which was shipped a few days ago to the Nicopal Mariopol Mining & Metallurgical company, Mariopol, Russia, and will furnish electric power to various machinery in the steel works of the Russian company. The company will ship in a few days to the Chicago Public Library four 200 horse power vertical cross-compound and one 100 horse power vertical tandem-compound engines, each engine being direct-connected to two General Electric machines. The form of arrangement and the details of these engines are entirely new, and the plant when erected will be a very complete one. Besides these there are building in the works at present one 400 horse power vertical cross-compound engine and one 150 horse power vertical cross-compound engine for the Schoenberger Steel company of Pittsburg, Pa., each of which is direct-connected to Siemens & Halske generators, and for the Apollo Iron & Steel company of Apollo, Pa., one 150 horse power vertical cross-compound engine direct-connected to a General Electric alternating lighting machine, both the dynamo and exciter being driven from the shaft of the engine and arranged on the same base with the engine.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued January 5, 1897.

574,370. Manufacture of Incandescent Electric Lamps. Thomas B. Atterbury, Pittsburg, Pa. Application filed December 18, 1894.

The method of making incandescent lamps consists in cementing an underground perforated stopper in the lamp by vitrifiable enamel or cement, and then heating to vitrify the enamel.

574,377. Electric Railway Trolley. Edward M. Bentley, New York, N. Y. Application filed July 28, 1896.

An electric railway contact device, of a laterally movable and pivoted arm, carries a wheel or roller at its outer end; an actuating spring for the arm is attached to a relatively stationary part, and an intermediate connecting device between the spring and arm is adapted to move laterally with the latter.

574,388. Electric Propulsion of Vehicles. William A. Butler, New York, N. Y. Application filed March 19, 1895.

The invention embodies a vehicle traveling on a track or way, a yielding elongated collecting shoe carried by the car, a distributing conductor, supports therefor arranged above the track, the conductor being insulated between such supports, a contact roller mounted to rotate upon a fixed shaft, whose support is electrically connected with the distributing conductor, and contact brushes attached to the shaft within the roller and rubbing against the interior face of the roller.

574,417. Secondary Battery and Process of Forming Same. George W. Harris and Richard J. Holland, New York, N. Y. Application filed January 30, 1896.

The process consists in subjecting lead plates to the action of an electric current in an electrolyte or bath composed of magnesium sulphate, sulphuric acid, acetic acid and magnesium acetate, and afterward subjecting the thus partly formed electrode to the action of an electric current in another electrolyte composed of dilute sulphuric acid and an acid sulphate.

574,430. Subway Conduit. Willbur H. Johnston, St. Louis, Mo. Application filed August 15, 1896.

The combination of a cable duct, a guideway located therein, a carriage adapted to travel in the guideway, means for imparting longitudinal motion to the carriage, a second cable duct disposed parallel to duct, an arm or projection extending from the carriage into duct, to which arm a conducting wire that is to be drawn through the duct is adapted to be secured.

574,536. Electrically Heated Sad-iron. William S. Hadaway, Jr., New York, N. Y. Application filed April 7, 1896.

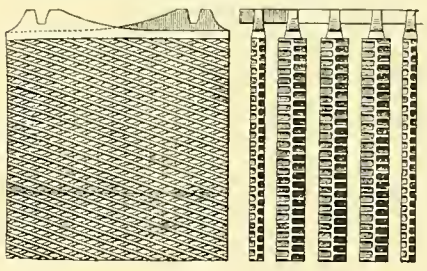
This is a flat or sad-iron having a plane smoothing surface bounded by a base-line and two side lines, in outline approximating a triangle combined with insulating material, and an electric heating conductor composed of helical convolutions arranged in three or more graduated sections, the section of greatest diameter being at or near the base-line, the section of smallest diameter being at or near the center, and the sections of intermediate diameter at or near the side lines.

574,537. Automatically Controlled Electric Oven. William S. Hadaway, Jr., New York, N. Y. Application filed May 4, 1896.

In an electric heating device there is the combination of a surface to be heated, an electric conductor in sections located in proximity thereto, a series of fixed contacts respectively connected to different points in the sectional conductor, a contact movable across the surface of the fixed contacts, an engaging point on the movable contact, a radial arm in position to engage the point but capable of independent movement, a thermal motor device and separable gearing connecting the motor device and radial arm, whereby the arm may be set and the extent of free movement thereof may be varied.

574,565. Electric Meter for Alternating Currents. Granville F. Packard, Fort Wayne, Ind. Application filed October 26, 1896.

A rotary armature is arranged in inductive relation to an energizing field of force, as shown, and is provided with a plurality of radial retarding devices so arranged relative to the field as to have induced upon their surfaces eddy or vortex currents whose field is opposed or repelled by the inducing field, thereby producing rotation.

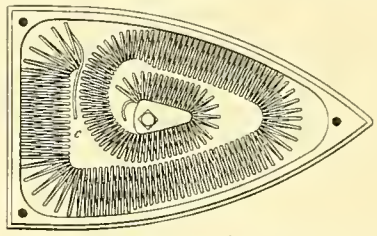


NO. 574,417.

574,579. Circuit for Annunciators of Telephone Lines. Charles E. Scribner, Chicago, and Frank R McBerty, Downer's Grove, Ill. Application filed May 14, 1896.

One claim is given: The combination with a telephone line equipped at its sub-station with a generator of signaling current, and at its central station including a spring-jack switch, and the magnet of an annunciator adapted to display its indicator when traversed by current, of a local circuit including the winding of the annunciator or a portion thereof, and separable contacts of the spring-jack together with a source of current, and switch contacts controlling said local circuit adapted to be closed together when the armature of the annunciator is attracted.

574,632. Electric Railway. William M. Schlesinger, Philadelphia, Pa. Application filed October 12, 1887.



NO. 574,536.

A feature is a current collector having two contact shoes arranged at an angle to one another and secured to a sliding bar or plunger, and spring-actuating devices for moving the plunger and shoes in the direction of the length of the plunger.

574,642. Telephone Switchboard. Henry J. Swarts, Knoxville, Tenn. Application filed December 24, 1895.

This switchboard comprises a table having a central opening, permitting an operator to be stationed therein, the arms radiating therefrom, and the annunciator boards adjustably mounted on the arms.

574,654. Telephone Receiver. Russell S. Barnum, Chicago, Ill. Application filed April 3, 1896.

A magnet-supporting bridge is placed at the end of the receiver case adjacent to and parallel with the diaphragm, and screws are inserted into the ends of the case beneath the bridge, so as to form rests or stops therefor.

574,669. Electric Clock. Charles M. Crook, Chicago, Ill. Application filed December 12, 1895.

The electrical feature consists of the electro-magnet and its armature, the lever which carries the latter having an abutment adapted to operate against the cam, and having an arm adapted to be stopped by collision with the frame in the movement caused by the attraction of the magnet for the armature, one of the colliding parts having an adjustment screw by which the collision may tend, with respect to the approach of the armature to the magnet poles and of the abutment to the end of the cam-track, whereby the armature may be prevented from contact with the poles, and the abutment prevented from giving a blow to the cam.

574,707. Automatic Telephone Exchange System. Lawrence G. Bowman, New York, N. Y. Application filed July 18, 1896.

An automatic telephone system is described, comprising a plurality of subscribers' lines and a central office, having a revoluble drum for each of the lines, the drums being provided each with peripheral contact plates corresponding in number to the subscribers' lines, connections between the subscribers' lines and their respective contact-plates on the drum, and a second connection from each subscriber's line to its respective drum, and means for moving the connection relative to the drum to engage the contact plates thereof successively and cut its line into circuit with a second line.

574,739. Electrical Measuring and Indicating Apparatus. John F. Kelly, Pittsfield, Mass. Application filed June 16, 1896.

A vibrating needle and stationary quadrants are separated from each other by a wall of insulating material.

574,828. Insulator. Benjamin D. B. Smock, Wickatunk, N. J. Application filed March 10, 1896.

An insulator consisting of a body portion with an opening to receive a wire and a ribbed wedge adapted to be inserted to hold the wire therein.

574,843. Method of Electrolytically Uniting Glass Tiles Into a Body. William H. Winslow, Chicago, Ill. Application filed November 2, 1896.

The method of forming tile sections into a body consists in bringing the several sections nearly together edge to edge, but with an open space between such edges interposing a foundation cathode electrical conductor between such edges, but so as still to leave a space to be filled between such edges, then subjecting the whole to the process of electro-deposition while the parts are in such position, and thus depositing a homogeneous mass of metal between the tile edges until the tile edges are permanently secured together by the engagement of the conductor and mass of deposited metal with each other, and with the tile between the edges thereof.

574,846. Fluid Pressure Regulator. Edgar H. Freeman, Rochester, N. Y. Application filed July 16, 1894.

There is the combination with the motor and pump, of a pivoted switch-arm, a pivoted crank-arm, a spring connecting the two on opposite sides of the pivot, a set of three electrodes so arranged that the switch rests in contact with all three when it is partially turned down, a fourth electrode so arranged that the switch rests in contact with all four when turned fully down, and electrical connections connecting the electrodes with a battery and the motor.

574,856. Electric Alarm Device. George V. Trott, Chicago, Ill. Application filed April 10, 1896.

The first claim is given: In a circuit-controlling device for electrically operated alarms, the combination with a plurality of possible contacts through which the circuit is open, of an adjustable member adapted to close the circuit through any one of the said contacts, and a rotatable contact piece adapted to prevent the actuating current from being transmitted to the alarm when the said contact-piece is in a single adjusted position during its rotation.

Western Electrician.
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John M. Roach.

As an illustration of the possibilities of advancement in street railway work in large cities and as an example of what may be accomplished by well directed, intelligent application and industry, the career of John M. Roach of Chicago serves as an object lesson. To his own individual efforts can be attributed his rapid advancement. He entered the street railway business 25 years ago at the bottom of the ladder, without influential friends to assist him or any advantages whatever except those of his own making. To-day he is at the head of a system of street railways, the magnitude of which was beyond the dreams of those engaged in that field in 1872. It was on October 7th of that year that Mr. Roach secured a position as conductor on a street car of the North Chicago City Railway company. He was 21 years of age at the time and had seen a good deal of the world, as he had a roving disposition and in early life had gratified this propensity to travel: but he was also of an observing turn of mind, and as a result of his experience he had acquired a fund of information that proved of great value to him in later years. Wherever possible he improved his knowledge of machinery and made a special study of the development and utilization of power.

At that time power transmission as known to-day was not thought of, but in all the work along that line Mr. Roach was greatly interested. It is scarcely necessary to say that he has kept in touch with the advancement that has been made up to the present time, and that he is thoroughly familiar with the merits and failings of the respective systems. But it is not for his knowledge of machinery and mechanical power alone that he has gained distinction. His success in handling men has been remarkable throughout his connection with the street railway development of Chicago. There are 10,000 men on the pay-roll of the system which is now under Mr. Roach's management, and, according to his statement, "they feel absolutely secure in their positions as long as they perform their duties satisfactorily." This is the explanation he gives of the successful manner in which the system has been conducted.

An idea of the growth of the street railway business in Chicago can be gained from a comparison of the condition of the business when Mr. Roach secured employment with the North Side company 25 years ago and the transportation facilities of to-day. In 1872 the North Side company operated 26 cars. Such service as was then considered sufficient would not be tolerated to-day. There were very few lines; the mileage was small, and, of course, the trips were not frequent. At that time horse cars were depended upon, and consequently the accommodations were poor.

After a short term as conductor Mr. Roach was made cashier of the North Side company. When Charles T. Yerkes secured control of the property he at once recognized Mr. Roach's ability and retained him in the service. With the extension and development of the Yerkes system Mr. Roach's duties increased, and when the time came for the introduction of mechanical power to supersede the old horse cars the knowledge he had acquired upon this subject proved valuable to the company. After the cable had been introduced upon the Clark street line, Mr. Roach gave personal supervision to every detail of operation, and when the cross-town and feeder lines were equipped electrically these too received his personal attention.

Upon Mr. Parsons' retirement from the West Chicago Street Railroad company this property was also placed under Mr. Roach's management, and to-day he may be said to be the active manager of one of the most important railway properties in the world—the Yerkes system of street railways in Chicago. An idea of the magnitude of the financial interests involved can be gained from an article on another page of this issue in which the annual reports of the principal companies are summarized.

Although Mr. Roach is financially interested in all of these corporations and is a member of the boards of directors of the several companies, it is in his capacity as a practical street railway man—that is, through his identification with the construction and operation of the roads rather than in shaping their financial policy—that he is most widely known. In this capacity he is probably one of the best known men in the street railway world. He is second vice-president and general manager of the North Chicago Street Railroad company, general manager of the Chicago Electric Transit company, general manager of the North Chicago Electric company, general manager of the North Side Electric company, vice-president and general manager of the West Chicago Street Railroad company, and this latter position carries with it the management of all the small suburban and feeder companies that contribute to the Yerkes system. It is a noteworthy fact that while it is true that from the day Mr. Roach entered the street railway business his advancement was rapid, it is equally true and even more remarkable that in all that time he has never pressed his claims for preferment. Every advancement and promotion came unsolicited, and in his 25 years' experience he never asked for an increase of salary. The value of his services to the company in every case won his promotion.

JOHN M. ROACH.

As has already been stated, the Yerkes system employs 10,000 men. It operates 57 miles of cable road and 480 miles of overhead electric trolley lines. Power is supplied for operating the 2,000 cars employed on this system from 11 stations, and the capacity of these plants is 50,000 horse power.

After the cable had been introduced in Clark street and while the people living along the routes operating horse cars were clamoring for quicker service, the prejudice against overhead electric wires was so great that the possibility of introducing the trolley system was scouted. In all this time the management of the Yerkes system made no attempt to substitute the trolley for the horse car. On the contrary, every other form of mechanical power that could be utilized for street-car propulsion was tried. Storage batteries were at that time the hope of the opponents of the trolley, but when a car was brought to this city from New York by the Accumulator company it was found that the storage battery had not reached the point where it could be considered commercially successful. The underground trolley system was also given a trial, and this, like the accumulators, proved a failure. Then gas motors were imported, but numerous objections were raised by the people where the experiments were being conducted, and this plan was discontinued. Then came the Connolly motor and the "soda motor," neither of which proved equal to the requirements of the service. All of these experiments were conducted under Mr. Roach's personal supervision When they had all failed, the people of the North Side became convinced that their only hope for good service was in the overhead electric trolley system, and sufficient influence was brought to bear upon the council to secure the necessary permission for changing the power. Mr. Roach, it may be said, is a firm friend of the trolley, and has always believed in its ultimate triumph.

Personally Mr. Roach is an affable gentleman and he has many warm friends in the street railway business. In spite of the exacting nature of his duties he finds time for social enjoyment, and he devotes some thought to public affairs. He is still a young man, having been born January 30, 1851. His birthplace was Marietta, Ohio, but he is a thorough Chicagoan in the best sense of the word.

Northwestern Electrical Association.

This week's meeting of the Northwestern Electrical association, like all former gatherings of this organization, awakened interest among central station men throughout the district from which the association derives its support. The members have not lost their enthusiasm for their organization, it is evident, from the expressions received by those in charge of the arrangements for the Milwaukee convention. Many of those who gave assurance of their intention to attend this week's meeting had not been present at some of the late conventions, and this is taken as an indication of renewed interest in the movement, which is of course very gratifying to the management. George Cutter promised that Chicago would send its usual delegation with a few additions to the list.

Among the events of the winter meeting is the election of officers for the ensuing year. An effort will be made to induce Mr. Mercein to continue in the office of secretary. His services to the association have been very highly valued by all who have had occasion to avail themselves of the information collected upon the subject of municipal operation of lighting plants and other subjects.

The programme prepared by the committee includes the reading of the following papers, to be followed by general discussion:

"Incandescent Lamps," F. S. Terry, Chicago.

"Protective Devices for Transformers," H. C. Wirt, Schenectady, N. Y.

"Gaseous Fuel as a Means of Cheapening Electricity," Nelson W. Perry, New York.

"Transformers," O. M. Ash, Elkhart, Ind.

"The Garfield Park Electrical Plant," Forée Bain, Chicago.

"Röntgen Ray Phenomena" (illustrated), Caryl D. Haskins, Boston.

"Electrical Construction Affecting Insurance," George S. McLaren, Milwaukee.

"Safety Devices for Electrical Circuits," Professor W. M. Stine, Chicago.

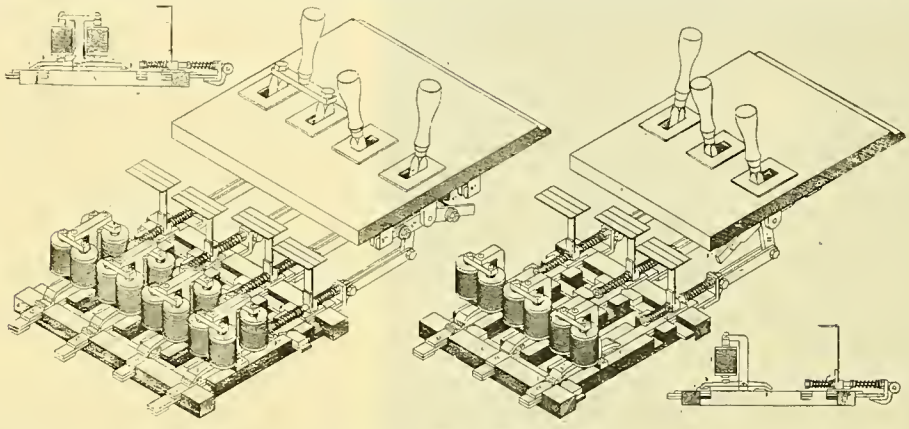
"Electrical Supplies," W. W. Low, Chicago.

Electric Interlocking System.

An interesting application of electric interlocking has recently been installed at the crossing of the Illinois Central and the Baltimore & Ohio Southwestern railroads at Edgewood, Illinois, which has a number of novel features giving promise of successfully meeting the problems of an interlocking mechanism by the use of electric power without the assistance of any other power. The plant has 18 levers, six of which control switches, eight operate home signals and four control distant signals. This apparatus was put into service November 24th, and it is reported to be working satisfactorily.

A dynamo of 1.5 kilowatts capacity driven by a three horse power Van Duzer gasoline engine develops the electric power for operating this plant. The dynamo is supplemented by a storage battery of 55 cells, having a capacity of 100 ampere-hours. The addition of the storage battery makes it unnecessary to run the engine more than about one day of 10 hours in the month for such a plant as the one at Edgewood.

The manual electric switches located in the tower for controlling the movement of the track switches consist of two distinct single-pole, double-throw switches connected to one handle, but insulated electrically from the lever and from each other. These are shown in the accompanying illustration, which is reproduced from the *Railway Review*. A two-pole, two-throw, pole-changing switch is connected to the rail switch operating mechanism, and is operated automatically by it. Two wires are led out from the tower to each switch, one for reversing it and the other for putting it into the normal position. One wire runs to each signal, and a common return wire leads from all the switches and signals in one direction back to the tower. To the signal operating



ELECTRIC INTERLOCKING SYSTEM.

lever only one single-pole, double-throw electric switch is connected. To each of the switch and signal levers an interlocking bar is rigidly connected. These bars are interlocked with one another in the same way as that employed in mechanical interlocking. But in addition to these primary bars, secondary bars are placed above them having flexible connections with the primaries. The secondary bars are prevented from making a complete movement in either direction by electro-magnetically controlled latches which hold them until the switch has made its complete movement. The flexible connection, however, permits the primary bar to make a complete movement at first. The primary bar might be called the locking bar and the secondary the releasing bar. The current for energizing the latch operating the magnet, or releasing magnet, as it may be termed, is derived from the switch operating motor after the track switch is completely home and locked.

In the normal position of the switch operating lever one of the electric switch bars connected to it, which may be called the normal bar, connects the generator with the normal wire, and the other switch bar, which may be called the reversing bar, connects the reversing wire with the return wire through one of the releasing magnets. In the reversed position the reversing wire is connected to the generator and the normal wire through the other releasing magnet to the return wire. In the normal position of the automatic pole-changing switch one terminal, which for the sake of distinction is termed the positive, of the switch operating motor armature is connected to the reversing wire, and the negative terminal is connected to the return wire through the field coils. In the reversed position of the pole changing switch the negative terminal of the armature is connected to the normal wire and the positive terminal with the return wire through the field coil. One terminal of the generator is permanently connected to the return wire, while the other terminal may be connected at pleasure with either of the leading-out switch or signal wires.

Everything being in normal position, if a switch operating lever be reversed, a circuit is formed including the generator and the corresponding switch operating motor through the reversing wire and the return wire. After the rail switch has made its complete movement, and is locked, this circuit is broken automatically by the reversal of the pole-changing switch and a new circuit established including the switch operating motor and one of the releasing magnets through the normal wire and the return wire, and independent of the generator. The momentum of the armature of the motor causes it to rotate after its connection with the generator is broken. This rotation generates a current which flows through the coils of the releasing magnet and serves the double purpose of lifting the latch that holds the releasing bar and of stopping the rotation of the armature of the motor without jar to the mechanism. It is found that four revolutions of the armature are sufficient to do this, while 48 revolutions are employed in moving and locking the switch. Obtaining the currents for releasing the locking from the motion of the switch motor makes the appliance absolutely safe as regards locking and indicating, as no current can be generated in the circuits employed for these purposes until the switch is completely home and locked. The connections are extremely simple, as the same wires that carry current for operating the switch are used to carry the currents which operate the releasing magnets.

In the reversed position of the signal operating lever the signal wire is connected to the generator and a current flows through the signal operating motor until the arm is brought down to the safety position, when it is automatically interrupted by a circuit breaker connected to the signal arm. The circuit breaker is shunted by a magnet of high resistance and the current is maintained through this magnet which presses a brake shoe on a drum connected to the mechanism, and holds the signal to safety without using the heavier current required for operating the signal motor. When the signal lever is put normal the signal wire is connected to the return wire through a releasing magnet. This forms a closed circuit including the signal motor and the releasing magnet, and the current generated by the rotation of the armature actuated by the counterweight energizes this magnet and releases the locking. This current serves another purpose also; that of retarding the fall of the counterweight. It does not, however, detract from the effective pull of the counterweight, because if the current could become strong enough to stop the weight, then the armature would stop and the current would cease. It only prevents the counterweight from acquiring too great a momentum.

Two arms on one post and governing two conflicting routes may be operated with one motor by rotating the armature in either one or the other direction, and using a pawl and ratchet mechanism for making the rotation effective on either one or the other of the signal blades. The direction of rotation is determined by a specially designed polarized pole-changing relay. The two signal wires, one wire being required for each arm on the post, are also used for conveying current to the relay, which effects an important saving in wire. The two corresponding signal operating levers, since one must necessarily be in the normal position when the other is reversed, together act as a pole changer for the relay referred to.

The methods of operating the different parts of the apparatus and of controlling the locking have been reduced to a system which precludes the chance of error from carelessness or derangement of any of the parts and adapts the mechanism to a plant of any size and in any location. As the power is transmitted through small wires, which do not move themselves and may be hidden away underground or otherwise disposed so that they will be out of the way, this plant has a much neater appearance than the well-known mechanical machines. The expense for power is almost insignificant and will probably not exceed one dollar per month for this plant, consisting of eight switches and 12 signals. An important feature of such apparatus lies in the fact that no care need be taken to drain the connections between the tower and the switches and signals. This will be appreciated by those who have had the responsibility of keeping mechanical plants in operation during the winter time, especially those which are located upon low ground. The motors used for this work are of the Crocker-Wheeler type; those for the switches being one-quarter horse power and the signal motors one-sixth horse power.

J. D. Taylor of Chillicothe, Ohio, designed the system under the direction of the Taylor Switch & Signal company. The work of installation was carried out under the supervision of W. J. Gillingham, Jr., signal engineer of the Illinois Central Railroad company.

Auxiliary Telegraphy.[1]

By Dr. I. Kitsee.

Telegraphy in the last score of years has made such rapid progress that it is hardly possible to increase the capacity of a line wire, or to facilitate the ease with which messages are transmitted or received.

We have quadruplex and multiplex systems. We can send a number of messages in opposite directions; but we cannot, if the terminals of a line are used for transmitting or receiving one kind of messages, transmit messages from and to intervening stations of such line without interfering with the telegraphic communications of the terminal offices. And the lack of a system permitting communication between intervening stations, at one and the same time, when the line is being used by the terminal offices, is generally a great source of inconvenience, but especially so on such lines running along railways, where the general business of the telegraph company must give preference to the business of the railway company. On such lines it very often happens that the main offices have to suspend business altogether for a considerable length of time in the midst of the busiest part of the day because the intervening railway stations have to exchange messages about some more or less important point pertaining to the railroad service. The device which I will describe to-night is designed to overcome this difficulty.

We will assume of have represented two telegraphic stations equipped with the Morse system, the sounders, and also with the auxiliary system, both stations joined together through wire resistance of 2,500 ohms, equal to about the resistance of the ocean cable. The first requisite of such device to be worked from intervening stations at one and the same time, when the line is used by terminal stations, is that there shall not be inserted in the line large resistance or batteries, or other generators of electricity which may come in conflict with the batteries of the terminal stations. The second requisite is that the current transmitted from the main stations shall not actuate the receiving or sending instruments of intervening stations, and *vice versa*. The third requisite is that the current used from intervening stations shall not be of too high a potential, so as not to injure the insulation with which common lines are provided. It must also be understood that no additional connections shall be introduced between line and ground.

It is believed that the "auxiliary telegraph system" about to be described answers all of these requirements: also, it has the great advantage that it is in itself a duplex, allowing the sending of messages in opposite directions simultaneously.

Generally considered, the equipment of the auxiliary system consists of a sending device, consisting of a small alternating dynamo, or, if such be not at hand, of a mechanical alternator, in connection with some batteries in the circuit, in which is placed a sending key and the primary of a converter. The secondary of this converter is connected in series with the line, and the tertiary of this converter is locally connected with the vacuum globe, which acts as a receiver. The primary, as well as the secondary of the converter, should be a low resistance one. The tertiary coil should be wound in such manner as to increase the electromotive force to an extent necessary for producing the glow in a vacuum globe.

Each of the stations, the sending as well as the receiving station, is also provided with a second primary, connected in series with the first primary. This second primary is placed into a coil equal in its inducing capacity to the tertiary first spoken of. The terminals of this coil, which I call the second or opposing tertiary, are connected in opposition to the first coil with the receiving vacuum globe. This second series of coils is necessary for the duplexing of the system.

Following is a short description of the mode of sending messages according to this auxiliary system:

At the sending station the operator connects his first primary coil through his sending key with the source of electricity. With the aid of this key he sends through

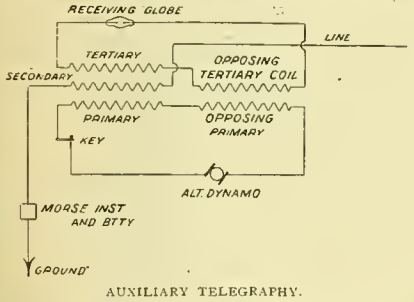
1. Read before the electrical section of the Franklin Institute, Philadelphia, November 25, 1896.

his primary coil currents of electricity. These impulses, which are alternating, induce impulses in the secondary, corresponding in time to the time of the flow of impulses in the primary. It will be understood that the operator, in opening and closing the key once, does not send a single impulse only through the primary, but a series of impulses, the flow time of which corresponds with the closing time of the key, a dot with its short closing time sending impulses through the primary for a shorter period than a dash with its longer closing time. As far, therefore, as the operator is concerned, he has to manipulate the key as if the current flow were a constant and not an alternating one.

These alternating impulses in the primary induce alternating impulses in the secondary. These impulses travel over the line, wire or cable, and through the secondary inserted in the line at the receiving station. We, therefore, have as a result of the sending of a message traveling over the line rapidly alternating impulses of such short duration that the other, *i. e.*, Morse or similar sending or receiving instruments, depending, as they do, on the movement of the armature of an electro-magnetic device, cannot respond and remain practically unaffected by the flow of these impulses. As around each of the secondary coils, sending as well as receiving station, the tertiary coil is wound, it follows that the alternating impulses, traveling through the secondaries, will induce alternating impulses in the tertiaries, and as the coils are wound to the necessary high potential, the generated tertiary impulses will, if the terminals of the coils are connected to a vacuum tube or device similar in its action, produce in said tube or similar device a glow, corresponding in time to the time of the electric impulses generated through induction—shorter glow-time for dot and longer glow-time for dash.

The office and function of the second primary coil has, so far, not been taken into consideration, and if this system is used only as a simplex one, then the addition of this coil is not necessary; but as set forth above, the object is to con-triplex or duplex the auxiliary of telegraphy, and the prime conditions to be fulfilled in practically carrying out the method of simultaneous transmission in opposite directions are:

(1) That the receiving instrument at the home station shall remain entirely unaffected by the movements of the transmitting key at that station, while at the same



AUXILIARY TELEGRAPHY.

time it shall remain free to respond to the currents transmitted by the key at the distant station.

(2) If this induced system shall be used in conjunction with the usual receiving and sending instruments, which are liable to be opened just at the time of transmission with induced currents, that the same currents shall always be provided with an uninterrupted passage to the ground, at the home station as well as at the distant station.

To fulfill the first condition is the office and function of the second primary coil. This coil is so wound or connected to the source of current that the alternating impulses flowing through it are capable of inducing in the second tertiary coil impulses of opposite direction from the impulses induced through the action of the secondary coil in the first tertiary.

The necessary adjustment of the inducing influence of one coil on opposing coil can be accomplished:

(1) Through the operation of a rheostat, through the action of which more or less resistance can be thrown into the circuit of the second primary; or,

(2) The second primary can be partially withdrawn from the inner space of the second tertiary.

Supposing now, the adjustment being perfected, the operator at one station is transmitting a message to the second station.

In depressing his key he sends a multitude of impulses through the primary, inducing thereby a multitude of impulses in the secondary, which multitude of impulses will induce tertiary impulses in the tertiary coil, and will flow over the line into the secondary of the second station, inducing impulses in the tertiary of the receiving station.

Ordinarily, the receiving instruments of both stations, the receiving as well as sending, would answer; but as the depression of the key at the sending station also sends, simultaneously with the sending of the impulses through its first primary, impulses starting at the same time and at the same frequency through its second primary, and as the inducing effect of such impulses is opposite from the induced impulses flowing through its first primary, it follows that both the influence of the first and second primaries on its teritary are neutralized, and that therefore the receiving instrument at the sending station will not respond.

The proviso of an uninterrupted passage for the induced current is fulfilled by shunting the key and instrument of the Morse, or similar devices, through a condenser.

As stated in the introductory remarks, the alternating current flowing over the line is of such low potential that it would not affect or injure the insulation of a submarine cable, and it is believed that it can be used with impunity on cables as well as land lines.

In conclusion it can be said that the tests of the chief electrician of one of our foremost telephone companies have established the fact that the leakage and induction from a line traversed by the currents of the auxiliary are not greater than the leakage and induction from a wire traversed by a telephonic current, and that, therefore, the application of this system to existing submarine cables is believed to be a practical one.

Bryan-Marsh Company in the West.

Many electrical men will be surprised, perhaps, to learn that the Bryan-Marsh company of New York has opened western headquarters at 1239–1240 Monadnock Block, Chicago, to obtain its share of the incandescent lamp business of the West. The company has engaged an extensive suite of offices and has appointed J. M. Hill as general western manager. All the business for the Bryan-Marsh company in this territory, beginning with Ohio and Kentucky on the East, as far west as the Pacific Coast, will be done under Mr. Hill's management.

J. M. Hill, as is well known, is one of the most experienced business men in the electrical field, and is known throughout the entire West as an aggressive and successful salesman. Mr. Hill's first appearance in the electrical field was in 1886 with the St. Paul Gas Light company, St. Paul, Minn. He left this company in 1891 to go with the Northwest Thomson-Houston company, which sent him to the Pacific Coast as special agent under H. W. Goode. He remained there until after the consolidation of the Edison and Thomson-Houston companies, when he was brought back by the new company to do special work at St. Paul. He became identified with the service of the Carpenter Electric Heating Manufacturing company, in the spring of 1893, and when that company broke up he entered the service of the Columbia Incandescent Lamp company of St. Louis and acted as that company's Chicago manager, also as general sales agent of the Wagner Electric Manufacturing company of St. Louis. He still retains his position with the latter company, but has of course resigned as Chicago manager of the Columbia company.

From the fact of Mr. Hill's large acquaintance and popularity, as well as his extensive knowledge of the "ins and outs" of the lamp business, it would be difficult to find a man better suited for the prominent position he will hold with the Bryan-Marsh company.

Incidentally it may be stated that there is good reason to believe that the Bryan-Marsh company proposes to carry out a most aggressive campaign for a largely increased lamp business throughout the West, and it is said that the company will leave no stone unturned to make itself felt in a way that will be largely to the benefit of western incandescent lamp consumers.

Trolley Conduit Favored for Proposed South Side Roads.

The Chicago City Railway company and the General Electric Street Railway company are fighting for a franchise to build an electric railway in Wabash avenue and other South Side streets. The former company prefers to use the overhead trolley, and the latter the Love conduit trolley system, while a great many of the property owners want neither. It is alleged that the City Railway company is paying $10 a foot in cash for frontage consents and that the General Electric company is promising to pay by contract the same amount when the tracks are laid, and it is admitted that the opposition to any line on Wabash avenue is not so vigorous as it was. At a recent meeting of the committee of aldermen having the matter in charge it was finally decided to amend the ordinance by striking out the clauses giving the company the right to operate by an overhead trolley and to widen and pave Thirty-seventh street two feet on each side. The ordinance thus amended was recommended for passage. The subject will come up in the council next week.

The route is as follows: Beginning at Twenty-third street and South Park avenue, in Twenty-third street to Canal street, in Canal street from Twenty-second to Twenty-third street, in Princeton avenue from Twenty-third to Twenty-fourth street, in Twenty-fourth street from Princeton avenue to Butler street. Beginning at Butler and Twenty-fourth streets, in Butler street from Twenty-fourth to Twenty-eighth street, in Twenty-eighth street from Butler street to Union avenue, in Union avenue from Fifty-seventh to Twenty-sixth street, in Thirty-seventh street from Wabash avenue to Dearborn street, in Thirty-seventh street from Fifth avenue to Union avenue, in Forty-third street from Princeton avenue to Halsted street, in Fifty-seventh street from South Park avenue to Wabash avenue, in Wabash avenue from Sixty-third to Thirty-seventh street, in Wabash avenue from Twenty-third to Thirty-seventh street, in South Park avenue from Twenty-third to Twenty-second street. The fare is fixed at five cents, with transfer privileges. The life of the proposed franchise is 20 years, and the bond is in the sum of $10,000.

Street Railways to Be Investigated.

Following the suggestion of Mayor Swift, made in his recent veto for the four-cent-fare ordinance, Alderman Martin introduced and secured the passage of the following order in the meeting of the Chicago City Council held on January 14th:

Ordered, That the mayor of the city of Chicago be requested to at once appoint from the members of this council a special committee of five, one member of said committee to be from the North Side, two members from the South Side, and two from the West Side, whose duty it shall be to at once convene and investigate the existing methods of street-car travel, its relations to public needs, and to report to this council what existing violations, if any, of rights now granted, prevail; what regulations benefiting the public may be adopted, together with necessary legislation as may be suggested, that the traveling public may enjoy increased and improved service throughout the limits of the city.

That the duties of said committee may be better subserved, it is ordered that all books, accounts, and annual reports of all public corporations existing by authority of the City Council of the city of Chicago engaged in street car traffic be open to the inspection of said committee. And that it shall be the duty of said investigating committee to report as soon as practicable to this council such findings and needed reforms as may be made necessary for the public good.

BRYAN-MARSH COMPANY IN THE WEST.—J. M. HILL, GENERAL WESTERN MANAGER.

England, America and the Metric System.

[From the European Edition of the *New York Herald*.]

British and American consuls agree in reporting that the foreign trade of their respective countries would be greatly benefited by the adoption of the metric system of weights and measures. With the exception of England and Russia, all European nations use the system; and, in view of the convincing testimony taken by the committee of the House of Commons last year, its adoption by England at an early day seems probable.

The United States years ago legalized the use of metric weights and measures, but did nothing to enforce their use. Just now her merchants are working to increase their trade with the countries of Central and South America, and as all these use the metric system there is a growing pressure for its formal adoption by Congress.

The House of Commons committee asserted that the use of the metric system would save one year's schooling of all the children in the United Kingdom, and houses engaged in foreign trade testified that its adoption would enable them to get on with fewer clerks. In America the local weights and measures used in the various states are particularly numerous and confusing, and the substitution of the uniform French system for all of these would be of inestimable benefit.

Work will soon be commenced on the erection of the proposed electric light plant in Winston, N. C.

Electric Elevators in Germany.

In view of the interest that is shown in this country to-day in the development of the electric elevator, the progress that is being made in Germany in the same line will be of interest to American engineers. It will be seen by reference to the cuts that there is much to be learned by those engaged in this work on the other side. Fig. 1 shows an elevator system operating at the passenger station of Dresden, where a triphase dynamo actuates a main shaft, which transmits motion through pulleys to a drum placed at the right, in a sub-basement. Two pulleys, either side of an idle pulley, one of which is run by a cross belt, give the necessary changes of direction, while in a state of rest the belt is inoperative, and the brake is set. The motor may be moved on rails to adjust the tension of the belt.

In other installations the drum is placed on the floor above the motor, and moved by reversing pulleys. In this case a not uncommon method of installing the motor below stairs is to place it on a species of teter—if the machine is not too heavy—and raise or lower it at will, to arrive at a proper tension of the belt through the weight of the machine. This form of installation is only applicable to a spasmodic service, either freight or passenger.

A third form is one in which the elevator may be run without a constant attendant—in fact, anybody who may want to use it. This form is shown in Fig. 2. The motor moves the drum carrying the rope, through a tangential screw and cog gearing. The brake is controlled by a weighted lever. The movement of the motor is controlled by the apparatus seen on the wall above and to the right of the machine.

A striking example of elevator service is that shown in Fig. 3, which is used as a convenient substitute for climbing a hill 60 meters in height. It performs the feat with ease in two minutes. There are two elevator cages, each capable of carrying six persons, suspended upon steel cables which run in pulleys at the summit. This pair of elevators has been in constant use since 1890, at Salzburg, at the foot of Mönschsberg (Monk's Hill). It is moved by a continuous current machine of 15 horse power. The illustrations are reproduced from *L'Industrie Electrique*.

Influence of Electricity on the Mining Industry.[1]

By Irving Hale.

The saving effected by electric power generated by water or by steam at some distant point where coal is cheaper than at the mine or mill, the convenience with which wires can be strung underground and electric machinery moved from place to place, the superiority of electric motors over steam and air engines for most purposes, the avoidance of exhaust steam underground and condensation in pipes, and the much higher efficiency of electric transmission as compared with compressed air—all of these advantages have combined to make electric power a favorite with all who have used it in mining and milling operations. Now that its success has been practically demonstrated in so many mines and the various kinds of electric mining machinery have been brought to such a degree of perfection, progress in this direction will be still more rapid.

The first application of electric power in mining was a small flat-friction hoist, equipped with a 7½ horse power street car motor and installed in 1888 in the Veteran tunnel at Aspen. This hoist is still on duty.

The largest electric hoist in the world is on the Free Silver shaft, Aspen. It is a flat rope, double reel, overbalanced hoist, equipped with a four-pole motor, and having a capacity of 10,000 pounds, raised 1,000 feet per minute. Actual tests have shown that over-balancing reduces the power to about one-third of what it would be if the hoist were not balanced.

The favor with which electric power has been received at Aspen is shown by the fact that it is used by 13 of the leading mines and mills, operating 34 motors aggregating 671 horse power.

The Aspen installation affords the best example of the direct current, moderate voltage (500 volts) system, which is satisfactory and economical where the distance of transmission is comparatively short—preferably not over one or two miles, although at Aspen some of the machinery is three to 3½ miles from the station.

The direct current high voltage (900 volts) system, is illustrated by the famous Virginius plant at Mt. Sneffels, near Ouray, which originally transmitted current about four miles to an altitude of 12,700 feet, for operating pumps, hoist, blower and mill, although the mine is now worked through the Revenue tunnel at a much lower elevation. Until recently the generating capacity has been 300 kilowatts (400 horse power), but an additional plant of the same capacity is now being installed.

As the direct current system requires an almost prohibitory investment in copper at distances beyond five or six miles (on account of the practical impossibility of using a much higher pressure than 1,000 volts with this class of apparatus), the San Miguel Consolidated Mining company (now the Telluride Power Transmission company) adopted the single-phase alternating system for its plant, installed in 1891, which contemplated a transmission of 10 to 15 miles; but as this system was not applicable to general mining purposes, the single-phase alternating motor at that time not being self-starting nor capable of speed regulation, it has recently been changed to the multiphase system.

Edward S. Stoiber, owner of the Silver Lake mines, Silverton, Colo., installed in 1894 the first three-phase alternating plant in this vicinity and the largest and most complete plant on that system for mining purposes in the United States. The present generating capacity is 300 kilowatts (400 horse power), supplying a 100 horse power motor running mill, 100 horse power motor geared to an air compressor, 75 horse power hoist, two 15 horse power pumps, 11 horse power for blowers, 10 horse power for machine shop and lights in mill, bunk houses, offices and residence. The available water power being insufficient, it is intended to install a high economy steam plant and additional generators aggregating, with the present machines, 1,200 to 1,500 horse power. This is a good example of the economy to be effected by putting the steam plant on a railroad, where coal is comparatively cheap and transmitting the power electrically to the mine, saving the cost of transporting fuel, which saving pays large interest on the cost of the electric plant.

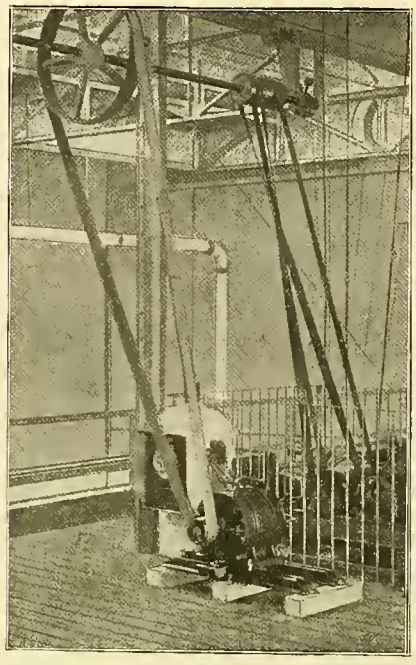


FIG. 1. ELECTRIC ELEVATORS IN GERMANY.—BELT-DRIVEN.

The Ontario Silver Mining company's three-phase plant at Park City, Utah, which transmits 200 horse power 6½ miles, using it for motors in machine shops and sawmills and for lighting purposes, is especially interesting, as it utilizes the water from the big drainage tunnel, which has until recently been pumped from the mine at enormous cost, to run water wheels and generate electricity, which is transmitted back to the mine and there used for power and light, thus changing a cause of great expense into a source of revenue.

Wilson & Jackson's three-phase plant at Pike's Peak, used for running the air compressor for driving the Strickler tunnel through the southern ridge of the peak, to bring additional streams from the west to the east side for the purpose of increasing the water supply of Colorado Springs, is worthy of attention for two reasons. In the first place, the water power for running the generators is taken from the pipe which brings water from Lake Moraine to the city, thus making the present water works system furnish the power required for its own enlargement. In the second place, the installation of an expensive plant solely for the prosecution of a temporary work requiring probably not over a year for its completion is evidence of the great economy effected by electricity under favorable conditions.

The Metallic Extraction company's electric pumping plant at Cyanide, Colo., used for pumping water from the Arkansas River, a distance of 3,700 feet, to supply the mill and town, illustrates another advantage of electricity, as the use of an electric instead of a steam pump at the river avoids the maintenance of a boiler and fireman at the pumping station.

The action of the Colorado Fuel & Iron company in replacing its compressed air pumping plant by an electric installation at the Rouse mine and the comparative tests made by Lewis Searing, the consulting engineer, and published by him in a recent article, establishes definitely and conclusively the enormous superiority of electricity over compressed air for power transmission purposes. These tests showed a total commercial efficiency of 50 per cent. for electricity and nine per cent. for compressed air, and revealed the surprising fact that with the electric plant they can do the same work with one boiler and five tons of coal per day which required eight boilers and 35 tons of coal with the compressed air system. It should be stated that the compressed air plant was not of the best and most efficient type in all respects, but the difference between its efficiency and that of the electric plant is so great that no possible improvement in the compressed air installation could overcome more than a small fraction of this difference. Moreover, the electric plant was so much underloaded as to be working at a great disadvantage, and Mr. Searing estimates that when it is doing all the work for which it was designed the total efficiency will approximate 60 per cent.

The extensive and profitable use of electricity in refining copper and incidentally recovering the gold and silver carried in the matte, at Anaconda and Great Falls, Mont., and numerous eastern plants, is well known, and the commercial success of the process thoroughly established. Electrolytic separation of the precious metals, although satisfactorily practiced to some extent, may be considered as still in the experimental stage, but the field is a promising one.

The Big Cottonwood Power company's 2,700 horse power 14-mile electric transmission plant, at Salt Lake City, and the 5,000 horse power plant, now almost completed by the Pioneer Electric Power company of Ogden, for supplying power to Ogden and Salt Lake City, 40 miles distant (the longest distance transmission in the world and the largest excepting Niagara Falls), while not for mining purposes, are good examples of the rapid progress that is being made in this direction, and indicate what may be done in the mining districts where the conditions are far more favorable to electric power on account of high cost of fuel.

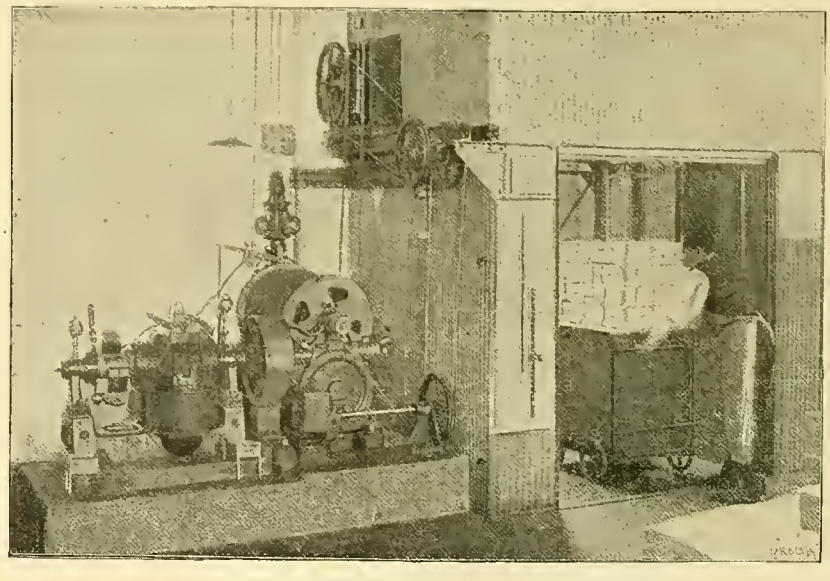


FIG. 2. ELECTRIC ELEVATORS IN GERMANY.—DIRECT-DRIVEN.

Without going into details of the saving effected by electricity generated by water or cheap steam power, it may be interesting to give some approximate figures on the subject. Allowing eight pounds of coal per indicated horse power hour (a low estimate for the average steam engine used in mining and milling work, as small hoists and pumps frequently take 12 to 20 pounds), one horse power used 24 hours per day for 365 days will require 70,080 pounds or 35 tons of coal, costing at $4 per ton $140 and at $8 per ton $280. The water power plant to run electric generators will generally not cost much more than the steam plant at the mine, which is saved by the use of electricity, and therefore need not be considered.

1. From the *Mining Industry and Review*.

The cost of electric plant per horse power will vary widely with sizes of generators and motors, length of line and other conditions, but for the average mining plant will generally be somewhere between $100 and $150 per horse power delivered by motors to the machinery which they run. Consequently if the total power is used continuously 24 hours per day, the entire cost of the electric plant will be saved about twice a year if coal costs $8 per ton, and once a year if it costs $4, or (in case electricity is generated by steam), if there is $4 per ton difference in price of coal between the generating station and the mine. This calculation leaves out of consideration the saving of firemen, handling ashes, water (which is a scarce article at some mines), boiler repairs, etc., and the incidental advantages of electric power mentioned in the first paragraph of this article.

That the advantages of electric power have not been unappreciated is shown by the fact that 50 mining and ore-treating companies in the Rocky Mountain district have

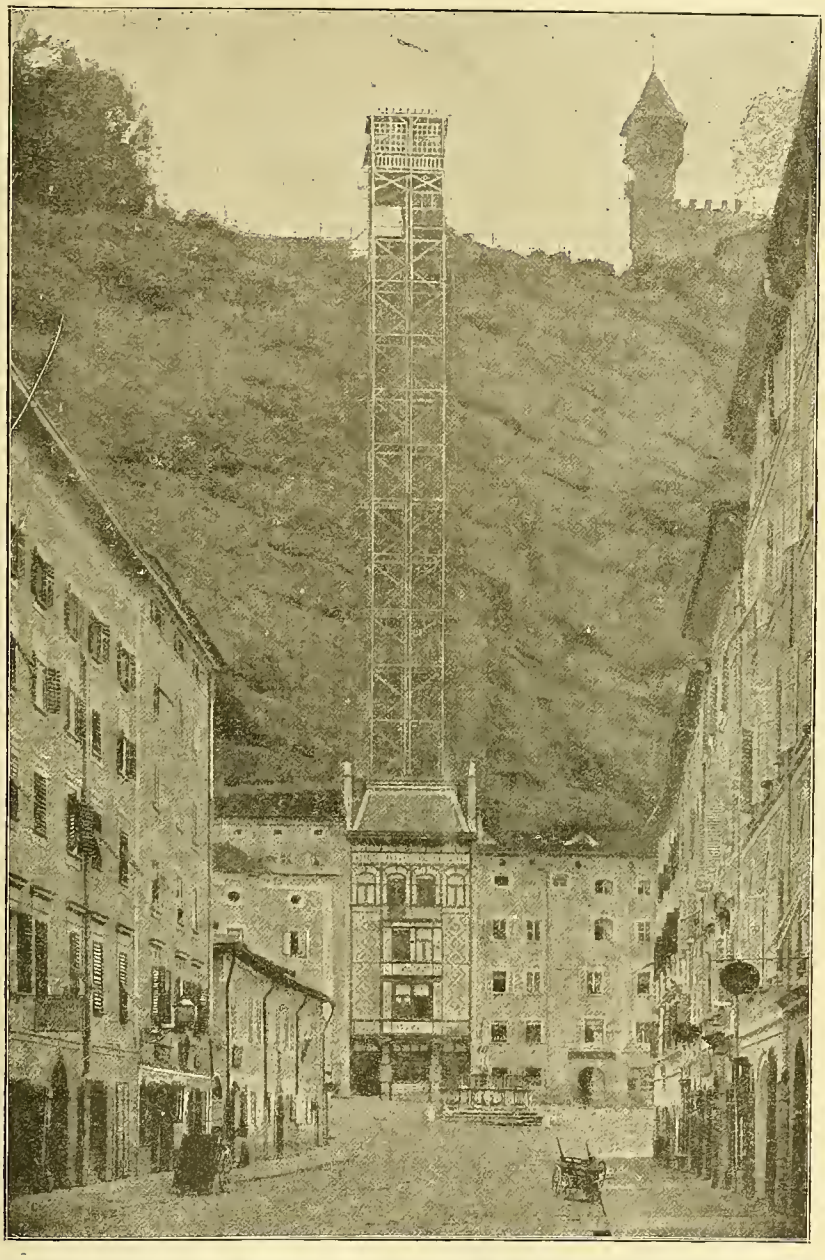


FIG. 3. ELECTRIC ELEVATORS IN GERMANY.—MÖNSCHSBERG ELEVATOR AT SALZBURG.

electric machinery aggregating 10,988 kilowatts (14,729 horse power) of generators and 5,201 horse power of motors, used for running hoists, pumps, blowers, air compressors, drills, locomotives, placer mining machines, mills, machine shops and miscellaneous purposes, thus covering practically the entire field of mining and ore-reducing operations. All this has been accomplished since 1888, during the first half of which period electric mining machinery was by no means as satisfactory as at present, and was being perfected by the hard knocks of experience, while the distance of transmission with the direct current low-voltage system was limited to a very few miles. Now that electric apparatus is more durable and reliable than steam machinery, and the three-phase system has made it possible to transmit power 50 miles as cheaply as it could be sent five miles four years ago, thus bringing almost every mining camp within effective range of electrically transmitted water power, there can be no question as to the influence that electricity will exert on the mining and milling industry by reducing the cost of mining, transportation and treatment, thus rendering profitable mines more profitable and unprofitable mines profitable, lowering the grade of ore that can be successfully handled and increasing the mineral output.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Northwestern Telephone & Electric company of Milwaukee has decided to build a toll line from Marinette, Wis., to Marquette, Mich., at once. The line will cost $15,000.

Subscribers of the Iowa Telephone company at Decorah, Iowa, think they are paying too much for their service, and suggest that $18 per year for a single instrument and $25 for two is a sufficient price. Forty-five subscribers, representing 60 instruments, have signed a statement to that effect, and now refuse to answer telephone calls, which cripples the service materially. Propositions to establish an independent system have been received from the Standard Telephone company and others.

The annual meeting of the Duluth-Superior Telephone company was held in Duluth, Minn., last week, resulting in the re-election of all the old directors. The company has strung 173 miles of new wire and added 80 new subscribers the last year.

There is strong agitation in Dubuque, Iowa, in favor of the proposed independent telephone exchange, as suggested by E. T. Keim of the Connecticut Telephone company.

Local capitalists at Zumbrota, Minn., propose to form a stock company and construct a telephone line to Red Wing. Two-thirds of the required stock has been subscribed.

There is some talk of extending the Aberdeen, S. D., telephone system to Ellendale and Oakes, N. D.

Telephone Notes from the South.

[From an occasional correspondent in Memphis.]

The telephone business is fairly good in the South. The great trouble is the scarcity of money. Collections are not good.

Albert Crow of Arkadelpha, Ark., is now manager of two telephone exchanges—one at his home and one at Poplar Bluff, Mo.

At West Plains, Mo., C. H. Gale has about 75 telephones in operation and is making arrangements to build a line 25 miles in the country.

The City Council of Corinth, Miss., has made a 10-year contract with Geo. W. Scheimy of Memphis, Tenn., by which the people of the former place are to have first-class telephone service at $24 for business houses and $18 for residences per annum. Jas. D. Randall will superintend the putting in of switchboard and telephones. The work is to be completed in 90 days from January 4, 1897.

Dr. D. C. Walt of Altheimer, Ark., is putting in a small exchange at that place and will connect it with Pine Bluff and several small places around Altheimer. The Utica Fire Alarm company's switchboard and the Viaduct Manufacturing company's telephones are used.

H. E. Hill is now managing the telephone exchange at Greenwood, Miss. He has about 60 telephones in service and will soon extend lines to the country.

Ohio Telephone Association.

At last week's meeting of the Ohio Telephone association in Columbus matters of interest to the independent companies were brought up. The matter of establishing an independent company in Columbus was discussed, some favoring the project. A franchise was granted to an independent company some time ago, but it has never been taken advantage of. The sentiment of the association was that if the independent company is not pushed the association ought to make arrangements for opening a long-distance station in Columbus. This is strongly advocated by the members as an outlet for the lines which they have all over the state.

After the new constitution had been adopted, the following-named officers, who were elected about a month ago, were re-elected under the new constitution: President, James M. Thomas, Chillicothe; first vice-president, D. J. Cable, Lima; second vice-president, George W. Beers, Fort Wayne; third vice-president, J. W. Hoyle, Cambridge; secretary, H. J. Critchfield, Mt. Vernon; treasurer, Edward Kibbler, Newark.

The different manufacturers of telephonic apparatus made creditable exhibits. It was the general opinion of the members present that it would now be only a short time until they would have a national association representing the 800 different independent telephone exchanges now being operated in this country.

The Trolley Wire as a Plaything.

Paul Solomon, 14 years old, the son of Meyer Solomon of 3255 Indiana avenue, was arrested in Chicago recently on a charge of malicious mischief. The charge was preferred by W. M. White, acting as the representative of the Chicago City Railway company.

On New Year's Day, it is alleged, Solomon and some companions threw a wire across the trolley wire at Indiana avenue and Thirty-first street and sought to have some fun with teamsters and smaller boys through the shocks contact with the wire might give. Solomon was warned that results might prove disastrous, and to the warning he is alleged to have said: "What of it? Coffins are cheap." Before the suspended wire was discovered and removed Edward Gard, 10 years old, of 3256 Indiana avenue, received a shock from the charged wire which confined him to his bed.

Consolidation May Be Effected.

The deal for the consolidation of the Fort Wayne and Siemens & Halske companies is not nearly as far advance as has been reported. Nevertheless, it begins to look as if it were going through. There are yet many chances of its failing, but it must now be admitted that the probabilities are in favor of its succeeding. The capital stock will probably be five million dollars instead of six millions and a half, as previously reported by an eastern contemporary.

Telegraphers to Meet at Peoria in May.

By a vote of seven to five, on January 13th, the executive committee of the Order of Railway Telegraphers located the next biennial convention of the order in Peoria, Ill. It will be held in May. Several hundred delegates are expected.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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WE may look for an editorial in an esteemed contemporary upon the necessity for accuracy in all publications, and more especially in those that discuss technical subjects. An eastern paper refers to "Joseph Wetsler, "the Electrical Engineer' and T. C. C. Martin, a writer on electrical subjects." And this is fame.

NOTWITHSTANDING the favorable report made on the overhead trolley system by the committee of inquiry that visited the United States, the street railway question at Glasgow is by no means settled, for the corporation has received an application from a firm to equip every tramway route in the city with mechanical traction. It offers to give a two months' trial, and to work the system for seven years at a cost of £100,000, which is stated not to exceed the present cost of horse haulage. The corporation seems disposed to consider the offer favorably. Consideration of the American deputation's report on electric traction, which was lately noted at length in this journal, was postponed.

THOSE who have pinned their faith to the Northwestern Electrical association should feel gratified by the revival of interest shown in this week's meeting at Milwaukee. The list of papers presented is sufficient guarantee of the character of the meeting, and the response that has greeted the present administration in all its work should make the incoming officers feel confidence in the future of the organization. Hearty co-operation of officers and members will not only keep the association in the front rank, but make it the leader of its kind.

SO MANY catalogues, pamphlets, price-lists and advertising slips of different classes and grades find their way to this office that in order to attract especial attention they must possess some peculiarity or special merit. Such a publication was found among those recently received, and it proved to be devoted to our old friend George B. Pennock of battery fame. Pennock and his schemes have already been introduced to the readers of this journal, and we allude once more to them merely to pay a tribute to the audacity of this promoter. The pamphlet is rather a cheap-looking publication, but the front cover is graced with a full length portrait of "Mr. Pennock, the star of all electricians," as the author styles himself. A noticeable feature of the book is an apparent lack of consideration for facts and a complete disregard for the English language.

THOSE who have favored surrounding electrical matters with an air of mystery will be interested in the statement of G. G. M. Hardingham of London, "that, as the result of the 'palace' interference with the administration in Turkey, patents for inventions which relate to the production of electrical energy, or in which electricity is in any way employed, are refused. The only explanation afforded by the Turkish authorities is that orders have been received 'from the palace.' Of course, the fees paid on application are retained." It is explained that perhaps Oriental ignorance in an intermediate official and a misinterpretation of the fear of overhead wires may have something to do with this order, as to give a patent and take a fee is an operation too much to the taste of a Turkish official for him to discourage fee-producing applicants of his own mere motion. At any rate, until the government modifies the present policy a Turkish patent cannot be considered a very valuable property.

IT is gratifying to note that the commerce committee of the House of Representatives has already taken up the subject of granting a subsidy for the building of a Pacific cable. At the hearing last week General Swayne said his company would not undertake the laying of the cable until the bed of the ocean had been properly surveyed. The English government, he asserted, would not lay its cable if the United States first enters the field. He referred to the existing conditions in the Hawaiian Islands, by showing that the Hawaiian people feel that they may not long remain an independent nation, and drew attention to the advantage this country would possess if it took immediate action upon this cable-laying project. He asserted that sooner or later they would cast their lot with some nation, and that nation would probably be the one which would put them in communication with the remainder of the world, and thus help them to build up their commerce. In answer to the objection raised against the payment of a subsidy by the government, General Swayne explained that in all civilized countries the telegraph is regarded as part of the mail service, except in the United States, where it is controlled by private persons, and, even here, it is merely an extension of the American postoffice system. All the cable bills before Congress, he said, relegated the details to the Postoffice Department, thus recognizing the cable as part of the postal service, which, he held, was not required to be remunerative; therefore the stipulation to pay the money of the United States in the form of a subsidy to the cable company for 20 years, was not strictly a subsidy, inasmuch as the government business is to be carried during that period free of charge. There was no inconsistency in that, he thought, as the mails were carried in some parts of the country by private persons who were paid for their service.

MORE than usual interest was shown in the announcement of the Assembly committee on "electricity, gas and water supply" in the New York Legislature last week. To the committee on electricity and gas will go all the bills for a reduction in the price of gas, which has become a popular subject for newspaper agitation, and whatever measures for the regulation of telephone business that may be introduced. Mr. Goodsell, the chairman of the committee, has been regarded as a reputable member. He is from Newburg, and will keep alive the state machine's solicitude for the corporations. Considerable surprise is expressed that such a man as Mr. Braun of Erie should be given second place on this important committee.

It is probable that matters of this kind will be referred to the special committee in the Senate which it is proposed to form for the purpose of investigating trusts. Senator Lexow instigated this movement, and he will probably be chairman of the committee. It would seem to be the purpose of the machine to have all bills relating to the price of gas, to electric lighting, to telephone rates, to the price of coal and other commodities, submitted to this special committee. Some experienced politicians question the motive which prompted this plan, but Senator Lexow says that he offered the resolution in good faith, in order that the Republican party, which will be held answerable for all the acts of the Legislature, could take the whole subject in hand and make such laws as would not only protect the public, but also prevent injustice being done to vested rights and invested capital. Such a policy would, of course, be highly commendable, and it is to be hoped that the great investigator is authorized to speak for his party, or, at least, that he correctly represents the sentiments of the members of that party in the Legislature.

Two important events have just been announced in local street railway circles which it is a pleasure to record, as both are in recognition of faithful services and are merited promotions. John M. Roach, who has for several years been at the head of the management of Mr. Yerkes' North Side lines, has been placed in charge of the Yerkes lines in the West Division, Chicago. This appointment places Mr. Roach in charge of all the North and West Side surface railway lines of Chicago and suburbs. The other change mentioned is the promotion of M. K. Bowen, superintendent of the Chicago City Railway company during the last four years, to the position of general manager, a title more in keeping with the duties and responsibilities of the position which Mr. Bowen has filled so acceptably. The properties with which Messrs. Roach and Bowen are entrusted are among the most valuable of their kind in the country. They represent an investment of many million dollars; they are heavy purchasers of machinery and supplies; they give direct employment to 15,000 men in the operation and maintenance of the numerous lines comprised in the systems, and they furnish the transportation facilities of the second city of the country. The importance of these enterprises to the community is far greater than can be indicated by any summary of this kind. It is not to be wondered, then, that the men entrusted with the management of these vast enterprises are regarded as public characters; their companies are engaged in public service, and they hold valuable franchises conferred by the public. But these men are also representatives of corporations and are required to show an annual dividend upon the investment which the property represents. Generally speaking, the interests of the public and the corporations are identical, but sometimes there are conflicting interests to be considered, and in such an emergency the general manager is made the object of much criticism. This has been the rule since the street railway business began to assume its present magnitude, and it will probably continue to be the order in spite of all remonstrance. But, in view of these facts, is it not only fair that where the public places responsibility it should also be willing to show recognition? There is much to be commended in the street railway systems of Chicago. Why not give a little credit to the men under whose direction these improvements have been introduced? There can be no question that the property is wisely managed. The annual reports, presented elsewhere in this issue show conclusively that the affairs of these companies are carefully conducted. Both of the men whose promotion is announced this week are practical and experienced street railway men, who have done much to increase the value of Chicago street railway securities, and their advancement is not only well earned, but it will doubtless be advantageous to the companies represented. Their good fortune gives pleasure to their associates in the street railway field.

M. K. Bowen.

The promotion of M. K. Bowen to the position of general manager of the Chicago City Railway company by the board of directors of that corporation at the annual meeting last week was a well deserved recognition of the ability and faithful service of the well known superintendent of the South Side system. Mr. Bowen has been in charge of the operation and construction of the road since his appointment as superintendent four years ago. His duties have been gradually increasing and his responsibilities growing, but as he has proved competent in every emergency it was determined to give him a title that would be in keeping with the nature of his duties. As general manager he will have absolute control of the company's business under the president and board of directors.

For one holding such a responsible position, Menard Kenner Bowen is comparatively a young man in point of years and service. He was born in Jefferson Barracks, Mo., the army post on the Mississippi River, 10 miles below St. Louis, in 1858. He was the son of General John S. Bowen, who was a graduate of West Point, and a grandson of Pierre Menard, the first lieutenant-governor of Illinois. He received his early education at the St. Louis University and later took a course in engineering at the Washington University in St. Louis. At the age of 19 Mr. Bowen went into the service of the United States government as assistant engineer on a triangulation survey of the Mississippi River. Later he was made assistant engineer of the jetty work in the harbor of New Orleans and the pass. In 1880 he became identified with the St. Louis & San Francisco railway in charge of the topographical survey from Fort Smith, Ark., through to California. He was engaged in this and similar work for several years and then entered the street railway field. His first important undertaking in this line was at Kansas City, where he became chief engineer and superintendent of construction of the Kansas City Railway company, which was building its cable lines at that time. He was very successful in this enterprise, and when the road was completed he was retained as general superintendent of the system. The field was of course limited, but Mr. Bowbn s ability and enterprise attracted attention and he was induced to go to New York as the representative of the Short Electric Railway company. At the end of a year he came to this city to accept the position of assistant superintendent of the Chicago City Railway company. One year later the reorganization of the management took place, and when it became necessary to select a superintendent the directors appointed Mr. Bowen. His record shows that the promise of his early life has been fulfilled. He has shown marked executive ability and a capacity for organization rarely combined in one individual. During the four years that he has filled the position of superintendent many changes and extensions have been made, methods of conducting the business of the company have been revised, new lines have been constructed, old roads extended and rebuilt and the motive power changed from horse to electricity on all but the trunk lines which were operated by cable. At the time Mr. Bowen assumed the duties of his position as superintendent there were no electric lines operated by the company. To-day there are 150 miles of electric road and 34 miles of cable. On these lines 598 cable cars and 478 electric cars are operated. Two new power plants have been constructed to furnish current for the electric system. The first, at Fifty-second street, has a capacity of 12,000 horse power, and the second, at Forty-ninth street, which is now only partially equipped, will eventually have double the capacity of the Fifty-second street station. New roads aggregating 24 miles have been built. The entire system, with little exception, is now equipped with cast-welded joints, the Chicago City Railway company being one of the first to adopt this construction as a standard, so that to-day there is a continuous rail without joints practically on the whole system. It will be of interest to street railway men to know that during the present season the company has not had one break in the rails. Another innovation in street railway practice introduced by Mr. Bowen was the use of a dynagraph car, which is an ordinary car equipped for the purpose of determining and showing the condition of the track over which it passes. The result of this test enables the management to determine just how much money will be required to reconstruct the track and put it in first-class shape. Mr. Bowen described this device and the method of operation, and related the results which he had obtained through its use, in his paper on "Track and Track Joints," which he read before the American Street Railway association at St. Louis last October. This paper, which was printed in the WESTERN ELECTRICIAN, November 7, 1896, may be said to have been his most notable contribution to the literature of street railway construction and operation. It attracted attention abroad as well as in this country, and provoked considerable discussion. It was generally agreed, however, that the dynagraph was an important addition to the equipment of every well conducted street railway. Many large companies have already taken steps to have a car of this kind constructed.

The beveled head rail first adopted by this company has resulted in the saving of the difference between 7½ and 3⅞ car wheels per day, as the output of its repair shops.

These were not the only improvements introduced in the management during Mr. Bowen's term. In the early days of cable railroading it was necessary to take the grips out of the grip cars on the street, thus blockading the line, and draw the grip cars by horses into the car barns. They were taken out in the same manner, and the trains were made up on the street. This crude method cost about $34 at each barn per day for labor, and resulted in numerous delays and blockades to service. The barn floors are now elevated 4½ feet above a sub-floor and are 16 inches higher than the street track. The trains are made up, grip hanging in place, and run out of the barns by gravity and run into the barns by momentum taken from the cable. The change has not only effected a material saving in the cost of operation, but it has greatly relieved the congestion at the car barns and greatly facilitated the service. Although Mr. Bowen makes no pretensions to inventive genius, he has demonstrated his ability to design and improve methods, so that his opinion has come to be regarded with respect upon all matters pertaining to street railway management. One of the subjects that proved troublesome at the beginning of his career was the proper method of heating cars. This matter has occupied a great deal of his time and attention, and he has finally succeeded in designing a car heater—the Columbia—which he says meets all the requirements of the most exacting service.

M. K. BOWEN.

The traffic on the company's lines last year, despite the hard times, was very heavy. During the year 1896 the road carried 95,238,915 passengers and earned $4,808,866. In order to carry on this great industry 5,000 men are employed in various capacities. These are all divided into departments, and the men in charge of the several forces constitute a board, which meets Mr. Bowen every Friday afternoon and devotes an hour to the discussion of some topic bearing upon the operation of the road. At these meetings, which, by the way, were begun almost immediately after Mr. Bowen became superintendent, and which have proved an important feature of his administration, there is a general interchange of views; criticism is freely passed and suggestions offered, and for the time being all are on equal footing. In this way Mr. Bowen keeps in touch with every department; he has the advantage of the views of experienced men on all subjects affecting the company, and while it stimulates in the men an interest in the work, it also affords him an opportunity of finding out the men with the best ideas and those which will prove most valuable to the company. It must be admitted, too, that this method has proved popular among the employes and profitable to the company.

Exposure of Barrett's Methods May Save $4,000 to the City of Chicago.

Immediately after Mayor Swift decided that new bids should be invited for the city fire-alarm contract, in view of the fact that the specifications of Swenie and Barrett virtually called for the Gamewell company's box, as detailed in the WESTERN ELECTRICIAN, Fire Marshal Swenie advertised again for bids. This was on January 5th. The specifications were modified, in accordance with the mayor's suggestion, so that competition was open to all who could produce boxes equal to the samples in the office of the city telegraph department. These samples were Gamewell boxes, and the first specifications made it a requirement that the bidders should furnish boxes exactly similar in all respects, which, of course, only the Gamewell company could do.

The proposals at the second bidding were opened at noon on January 16th by Chief Swenie. The bid of the United States Fire & Police Telegraph company was $3,375 for 75 fire-alarm boxes, or $45 for each box. In his letter to the mayor protesting against the manner in which it was proposed by Swenie and Barrett to award the contract at first in defiance of the interests of the taxpayers, J. W. Johnson, the western agent of this company, guaranteed to save the city $40 per box, or $3,000, under the Gamewell company's bid of $100 per box. The actual bid will save the city $55 on each box, if it is accepted. On 75 boxes this amounts to the considerable sum of $4,125. The second bid of the Police Telephone & Signal company (the western agent of the Gamewell company, and in which Barrett is said to be interested) was to furnish 75 fire-alarm boxes and 25 police telegraph boxes for $9,375, putting in the fire boxes at $100 each and the police boxes at $75 each, as before.

At this writing no award has been announced, and it remains to be seen whether the municipal authorities of Chicago will conclude to effect a saving of over $4,000 of the people's money by using boxes which in other cities are said by fire department officials to be fully equal to the Gamewell boxes. The action of Messrs. Swenie and Barrett will be closely scrutinized by press and public, as of right it should be.

Electrically Operated Printing Establishment.

Chicago is soon to have a thoroughly up-to-date electrically operated printing establishment. The R. R. Donnelly & Sons company has broken ground on Plymouth court, near Polk street, for a seven-story building, which it expects to occupy by May 1st. The electric plant which will be installed will, beside lighting the building, furnish power for running 25 presses, each of which will be operated by an individual motor. There will also be 10 small presses, which will be grouped and run by two motors. The folding machines, paper cutters and binding machines will be operated in a similar manner. While there are in the city some instances of printing presses run by motors, this will be the first printing and book-binding establishment in Chicago to be operated exclusively by electric power. The installation of the plant and the engineering features are in charge of Charles A. Pratt.

Appreciation in Brooklyn,

[From the *Brooklyn Manufacturer.*]

One of the most valued of our exchanges is the WESTERN ELECTRICIAN. It is ably edited, admirably illustrated and tastefully printed. It is a Chicago publication, weekly, at $3 per annum.

Annual Reports of Chicago Street Railway Companies.

Several of the important street railway companies of Chicago, operating on surface or elevated tracks, held their annual meetings last week. The big North and South Side companies show an increase of business over 1895, while a slight decrease is reported from the West Side. Below are given abstracts of the annual reports. The statistics of operation and of financial return are not arranged in uniform style—another instance of the disadvantage of the lack of a standard method of keeping street railway accounts—but the figures are interesting and can be easily compared:

CHICAGO CITY RAILWAY COMPANY.

The annual report of President Wheeler showed that the company had carried during the year a total of 95 238,915 passengers, an increase of 6,432,454 over the traffic of 1895. Both the cable and horse car lines showed a decrease from the figures of the previous year, but there was enough of an increase in the traffic of the electric lines to more than make up for the falling off in these receipts. The company earned in all a total of $4,808,866, and its expenditures were for operating expenses $1,831,658 and for interest on the bonds of the company outstanding $207,877, leaving net earnings of $1,623,780. This gave the company earnings of 15.11 per cent., but there was a charge of $181,568 for depreciation and for the reconstruction of the Wabash and State street lines, which cut down the net earnings applicable to stock to $1,442,212, which is equal to 13.42 per cent. The company paid 12 per cent. dividends upon its capital stock, which was $10,000,000 at the beginning of the year and $12,000,000 at the close, and carried $152,425 to the credit of the surplus account.

During the year the company ran its cars a total of 24,552,900 miles. This was an increase of 2,611,000 over the figures of the preceding year. The operating expenses were 62.52 per cent. of passenger receipts and 61.90 per cent. of total receipts.

The present capitalization of the company gives a total of 120,000 shares of stock outstanding. Of this number there was represented either in person or by proxy a total of 94,134 shares, and all these voted in favor of the only ticket put in the field. The directors put in nomination were: Samuel W. Allerton, James C. King, L. Z. Leiter, D. K. Pearsons, Erskine M. Phelps, William B. Walker and George H. Wheeler. At the meeting of the directors, following the stockholders' meeting, the following-named officers were elected: President, George H. Wheeler; first vice-president, James C. King; second vice-president, E. M. Phelps; treasurer, T. C. Penington; secretary, F. R. Greene; general counsel, Julius S. Grinnell. M. K. Bowen, formerly superintendent, was promoted to the position of general manager.

The figures given in the report of the president and treasurer of the company for the year, as compared with the corresponding figures for 1894 and 1895, make the following showing:

	1894.	1895.	1896.
Capital stock	$9,000,000	$10,000,000	$12,000,000
Bonded debt	4,619,500	4,619,500	4,619,500
Mileage—	1894. Miles.	1895. Miles.	1896. Miles.
Cable	34.47	34.77	34.92
Electric	74.22	117.81	141.76
Horse	52.63	9.79	4.09
Totals	161.62	162.37	184.22
	1894.	1895.	1896.
Total traffic earnings	$4,239,749	$4,440,323	$4,761,945
Earnings from other sources	24,869	36,501	46,921
Total income	$4,264,618	$4,476,824	$4,808,866
Operating expenses	2,838,684	2,807,726	2,977,208
Net earnings	$1,425,934	$1,669,098	$1,831,658
Interest	207,877	207,877	207,877
Earnings on stock	$1,218,057	$1,461,221	$1,442,212
Regular dividends	1,080,000	1,140,000	1,289,787
Surplus	$ 138,057	$ 321,221	$ 152,425
Passengers carried—	1894.	1895.	1896.
Cable	54,690,808	53,359,829	46,435,411
Horse	20,589,363	6,918,616	2,874,631
Electric	9,514,816	28,528,016	45,928,873
Totals	84,794,987	88,806,461	95,238,915
Miles run—	1894.	1895.	1896.
Cable	15,231,400	14,872,580	13,908,190
Horse	3,965,750	1,542,560	626,690
Electric	1,850,260	5,526,760	10,018,020
Total miles run	21,047,410	21,941,900	24,552,900
Cost per car mile—	1894. Cents.	1895. Cents.	1896. Cents.
Cable	9.97	10.240	10.540
Horse	25.39	30.550	25.889
Electric	16.90	14.776	13.467
Average all	13.457	12.796	12.126
Percentage expenses to income	66.56	62.72	61.91
Increase in traffic	.....	4.84	7.25
Earnings on stock	13.55	14.41	13.42

WEST CHICAGO STREET RAILROAD COMPANY.

The gross earnings were $182,528 less than in 1895, while the decrease in net earnings amounted to $53,711. The amount applicable for dividends was 6.55 per cent. on the capital stock, against 7.82 per cent. in the previous year. The increase in fixed charges was $114,098, representing interest on the increased floating obligations of the company. The statement of coupon interest showed no increase, while miscellaneous interest charges showed an expansion from $169,702 in 1895 to $380,916 in 1896. At the annual meeting a year ago an effort was made by stockholders to learn the amount of the floating debt, but Mr. Yerkes skillfully dodged the question. Last week he said that it now stood between $3,000,000 and $4,000,000. He explained that negotiations were now pending for the sale of the $10,000,000 of consolidated bonds. Of this sum he said $4,000,000 would be reserved to retire the first-mortgage bonds, $2,700,000 applied to the retirement of a like sum of debentures outstanding, and the remaining $3,300,000 used in the liquidation of the floating debt. After the $10,000,000 consolidated issue had been placed, Mr. Yerkes said, and the company was able to dispose of about $900,000 of Chicago Passenger Railway bonds and $450,000 of Cicero & Proviso bonds, the floating debt would be obliterated and the company would have a cash surplus of about $1,000,900.

The last of the Elkins-Widener interest in the West Chicago company disappeared in the retirement from the directory of John B. Parsons and W. L. Elkins. Their successors are J. M. Roach and H. T. Weeks. The following-named directors were re-elected: Charles T. Yerkes, F. H. Winston, G. A. Yuille, S. W. Rawson and W. F. Furbeck. Mr. Roach succeeded Mr. Parsons as vice-president and general manager, but otherwise the list of officers was unchanged.

President Yerkes' report is particularly interesting as showing the result of adopting electric power. It is as follows:

"Considering the fact that we have had an extremely dull season, from which all kinds of business appeared to suffer, our results may be considered as satisfactory. The gross earnings of the company are $4,018,948 45, which is a decrease of $182,528 87 from last year. The operating expenses were $2,138,378.55, being a decrease of $128,816 90. The net earnings were $1,880,569 90, being a decrease of $53,711.97. From this is to be deducted fixed charges consisting of rent of leased roads, Chicago West Division Railway company, Chicago Passenger Railway company, also interest and taxes, amounting in all to $1,016,114.18. There is applicable to dividends $864,455.72, being 6.55 per cent., which is a decrease of $167,810.30. The dividends amount to $791,340, which leaves a balance to be carried to the surplus fund of $73,115.72.

"As is a well-known fact, the business of this company has been interfered with very materially during the last year in two ways: first, the extension of the Metropolitan Elevated southwest increased the amount which that company was already taking from our road. About the time this was being fairly overcome, the hard times of the last six months of the year commenced, and the result is as might be expected. You will notice, however, that the operating expenses were very materially cut down, so as to meet this stagnatation of business. The summer months were most disappointing, inasmuch as the management had made preparations for amusement travel during that season. It amounted last year to almost nothing. We have one advantage, however. The equipment which was provided during last year will be in good shape and ready for business this year should we have better times. The electric tracks are practically finished.

"During the year we have disposed of 1,451 horses, and have now employed in the propulsion of cars about 165. As soon as horses could be got rid of and it was demonstrated it was necessary to cut down expenses, every effort was made by the management to accomplish this end. The results are not perceptible until the latter part of the year, for it was not until the month of September that the horses could be readily disposed of. Since that time there has been a decrease in expenses of about $40,000 a month, which, as you will notice from the figures, is about the same amount as the decrease in expenses for the whole year. That is to say, during the first nine months of the year the expenses were practically the same as for the last year, and while 12 months show a decrease in net earnings, the last three months, notwithstanding the decrease in receipts, show an increase in the net earnings, for the reason that the decrease in expenses is larger than the decrease in receipts.

"The building of power houses, changing of horses to electric power, accumulating large amounts of real estate, etc., have caused the expenditure in the last six years of over $6,000,000, which had to be provided for by the issue of debenture bonds; $2,700,000 of these bonds have been sold and there are $3,300,000 on hand, the sale of which is necessary to pay off the debts incurred for the improvements. As financial institutions did not look with favor upon the debenture bonds, which were really only promises to pay of the railroad company, without any mortgage behind them, it was deemed advisable by the management to issue a consolidated mortgage of $10,000,000, to be applied as follows: Four million dollars to take up the first-mortgage bonds of this company, which were issued at the time of its organization; $2,700,000 to take up the $2,700,000 debenture bonds already sold, and $3,300,000 to dispose of in order to pay off the floating debt. The negotiation for the sale of these bonds is still pending, and it is expected when they are sold, together with other bonds which the company now holds, that the whole floating debt of this company will be obliterated, and over a million dollars of cash still be on hand. As you no doubt are aware, it has been the policy of this company to control feeder lines, and to that effect the company has guaranteed the bonds of other companies. I am pleased to say that all of these companies are now earning more than their fixed charges, so that practically no responsibility rests on this company. It was also deemed advisable for the interests of the company to make a lease of the Cicero & Proviso Street Railway company for the purpose of preventing it from getting into adverse hands. The lease, however, provides that there shall be no set price paid to the Cicero company, but that it shall be operated by the West Chicago Street Railway company, and the profits, whatever they may be, turned over to the Cicero company. As to the future, it is not worth while for me to give an opinion. As we are going now, it looks as though we would make more money than we did last year. If business improves we certainly will do so."

The stockholders ratified the contract with the Cicero & Proviso and the Ogden Street Railroad companies, and also the acts of the officers during the last year. Mr. Yerkes asserted that it would be the policy of the company to control all outside lines, as well for the protection of the West Chicago corporation as to increase its revenue.

The treasurer's statement was as follows, comparisons being made with the report for 1895:

INCOME.	1896.	1895.
Passenger earnings	$3,973,895	$4,157,237
Other sources	45,053	44,340
Total income	$4,018,948	$4,201,477
EXPENSES.		
Conducting transportation	$1,219,416	$1,252,419
Maintenance of way	83,041	99,758
Motive power	454,928	526,698
Maintenance of cars	133,495	92,863
General expenses	247,495	295,455
Total expenses	$2,138,378	$2,267,195
FIXED CHARGES.		
Rentals	$ 493,407	$ 490,500
Coupon interest	241,800	241,813
Other interest and taxes	280,916	169,702
Total fixed charges	$1,016,114	$ 902,015
SUMMARY OF OPERATIONS.		
Gross receipts	$4,018,948	$4,201,477
Operating expenses	2,138,375	2,267,195
Net earnings	1,880,569	1,934,281
Fixed charges	1,016,114	902,015
Earned on stock	864,455	1,032,266
Dividends paid	791,340	791,340
Surplus for the year	73,115	240,926

The income from cable lines was $1,701,306, a decrease of $426,034, and the income from horse-car lines was $255,105, a decrease of $987,428, while the income from electric lines was $2,017,482, an increase of $1,230,120; the expenses of the cable lines were $888,539, a decrease of $81,415; the expenses of horse-car lines were $347,284, and the expenses of electric lines $902,554, making a decrease in the cost of operating horse and electric lines amounting to $47,363.

The expense of operating a car a mile was 13.88 cents for the cable, 20.77 cents for horse car lines, and 10.69 cents for electric lines. The average cost per passenger was 3.87 cents.

NORTH CHICAGO STREET RAILROAD COMPANY.

An increase in traffic was shown. The gain in gross earnings, however, was absorbed by increased operating expenses and fixed charges, the net earnings being $995,091, against $997,127 in 1895. For the first six months there was an increase of $130,000 in net income, but the extreme depression of business in the last half of the year resulted in a sharp decrease. The total number of passengers carried was 56,523,620, which compares with 53,887,428 in the previous year.

The capital stock was increased from $5,500,000 to $6,600,000 last year, and on this increased sum the net earnings amounted to 15.07 per cent., against 18.12 per cent. on the smaller amount in 1895. Of the 66,000 shares of stock 10,445 was represented in person and 34,885 by proxy, the entire number being cast in favor of Charles T. Yerkes, Frederick H. Winston, Warren F. Furbeck, J. William Helm and Hugh McBirney for directors. Mr. McBirney succeeds Charles Henrotin, this being the only change in the board. Mr. Roach, the former superintendent, was advanced to the position of general manager.

Mr. Yerkes' annual report contained the following:

"The fact that we have increased our bonded debt and also capital stock, at the time the extra dividend was declared a year ago, makes our fixed charges larger. The results, however, are as follows: Receipts for 1896, from all sources, $2,913,710, against $2,780,487 for the year 1895; the operating expenses for the year 1896 were $1,400,053 98, against $1,312,107.63, leaving net earnings for 1896 $1,506,787.63, against net earnings for 1895, $1,468,379.59; the fixed charges for 1896 were $530,381.45, against $471,251.97, so that the amount of net earnings for 1896, after paying all expenses and charges, was $976,406.18, against $997,127.62 for 1895; after paying all dividends for 1895, including extra dividend, there was a surplus of $594,281.20, which, added to the amount of earnings for 1896, gave a total of $1,570,687.38, from which dividends amounting to $758,901 have been paid, leaving surplus to be carried to the year of 1897 of $811,786.38. It is hardly worth while for me to explain to you that the condition of business generally has reflected itself upon our street railroads. In fact, the summer months, when we expect to make most of our money, were extremely dull, and the preparations made for taking advantage of our electric equipment, in the way of giving extra inducements for riding, were practically thrown away. We have the satisfaction, however, of knowing that it will be in good shape and ready for use this coming year. It has been the policy of this company to make running arrangements with the other companies under our control, to the effect that the public could be benefited and more perfect facilities given to different lines being operated, to the end that more traffic might be thrown on the various lines. This company is at the present time using the tracks of the West Chicago Street Railroad company to a consider-

able extent, and in consequence thereof this company has arranged with the West Chicago to pay the expenses of changing those lines from horse to electricity, we to be reimbursed by the sale of the bonds by the West Chicago company. The sum expended in that manner, together with the proportionate share of construction of power houses, has been $1,300,000. We anticipate this sum will be in a short time entirely paid. I would also state to you that the different companies for which this company has guaranteed bonds are now earning more than an amount sufficient to pay their fixed charges, so that the guaranty of this company really costs it nothing, and at the same time we derive great advantages from the connections. As time goes on I see more and more the wisdom of the plan of controlling these connecting companies. In regard to the business of the future, it is needless for me to speak, as you all can judge whether the prospects are better than for the last year. They certainly can be no worse. I can only say that we are now splendidly equipped, thoroughly organized and ready to do any amount of business that may be brought to us."

Mr. Yerkes was asked by a stockholder when the Northwestern "L" would be ready for operation, and replied within a year. Regarding its probable effect upon the earnings of the North Chicago company, he said: "In considering the Northwestern road it must be held in mind that it was constructed on a different theory from the other elevated roads in this city. The others were built by men who wished only to sell the stocks and who were not looking for a permanent investment. The lines were made to compete with the surface roads. They were built parallel with established lines. The Northwestern "L" was laid out so that it does not come into competition with the North Chicago lines for more than three blocks at a stretch. While it certainly will draw from the traffic of this company, the natural increase which we have each year will compensate for any diversion of traffic. It is far better that we should have built the road than an interest which was unfriendly to us, and I do not regard its operation with any fear of the effect on this property."

The issue of bonds in order to make advances to the West Side company is explained by the fact that the North Chicago corporation obtains use of tracks owned by the other Yerkes concern.

In answer to a question regarding the probability of change in the dividend rate, Mr. Yerkes suggested that it might be desirable to double the capital stock, reducing the dividend rate one-half This hint was taken as indicative of future action by the directors, although Mr. Yerkes said the question had not been discussed formally.

The report of the treasurer was as follows:

INCOME.

	1896.	1895.
Passengers	$2,826,800	$2,694,359
Other sources	86,909	86,128
Total income	$2,913,710	$2,780,487
Operating expenses	$1,394,387	$1,312,107
Net earnings	$1,519,322	$1,468,379
Fixed charges, rentals, etc	524,231	471,251
Applicable to stock	$995,091	$997,127
Surplus brought forward	594,281	1,357,075
Totals	$1,589,372	$2,354,203
Regular dividends	758,901	659,922
Surplus balance	$ 830,471	$1,694,281
Deduct extra dividend January, 1896	.....	1,100,000
		$ 594,281

Following are given details of operation:

	1896.	1895.
Total passengers carried	56,523,620	53,887,428
Total mileage	10,590,036	9,697,326
Percentage net earnings on capital stock	15.07	18.12
Percentage operating expenses to gross earnings—		
Cable	47.13	39.9
Electric	51.23	45.2
Horse	90.98	91.2
Average	49.32	47.72

The total receipts from cable lines were $1,535,311, and expenses, $693,532; receipts from electric lines, $1,192,601; expenses, $610,893; receipts from horse-car lines, $98,887; expenses, $89,962. The cost per car mile was for cable, 13 cents; for electric cars, 12.5 cents, and for horse cars 22 cents.

LAKE STREET ELEVATED RAILROAD COMPANY.

President D. H. Louderback's report showed an increase of $36,588 in net earnings. The deficit for the year was $13,911, against a deficit of $38,148 in the previous year. The average daily traffic was 30,208, a gain of nearly 3,000, almost all of which was secured by the extension in Wabash avenue made early in November. The gross income of the road was $56,362 greater, while operating expenses were reduced from 61.78 per cent. of gross earnings to 59.16 per cent.

The terms of three directors expired. W. F. Furbeck and M C. McDonald were re-elected, while C. D. Hotchkiss was elected to succeed Solomon Sturges. The total number of shares voting was 58,977. The shares represented by proxy include the trust receipts, which are held in trust and controlled by the present management.

President Louderback's report was as follows:

"Owing to the general depression in all business, the results for the last year have not been up to our expectations, although the net results are better than the previous year.

"The treasurer's report shows:

Gross business for the year	$573,668.70
Expenses	339,382.54
Net	$234,286.16
Fixed charges, taxes, miscellaneous interest	248,198.13
Deficit	$13,911 97

"During the year we have reduced the amount due on coupons unpaid, January 1, 1895—held by American Trust and Savings Bank in the interest of Columbia Construction company—$65,000, leaving a balance of $67,575 due on that account. We have equipped the road electrically at an expense of $341,813.56, and started its operation September 20, 1896. Everything is working in a satisfactory manner, and we have been enabled to make some material reductions, and others will follow as soon as our motormen become thoroughly efficient and learn to run their motors economically, and we get the full benefit of our electrical distribution of power from the nearest power house. We began running our trains to Wabash avenue and Adams street November 8, 1896, which added about 3,000 passengers a day. Without this extension we would be that much more behind in our last year's business. The road is being operated as economically as possible for the number of passengers carried, and we shall now have to rely on the natural growth of our territory and such increased traffic as the completion of the loop may bring us."

The statement of capital and liabilities was as follows:

Capital stock outstanding		$10,000,000.00
Bonds outstanding		5,928,500.00
First mortgage 5s	$ 979,000	
Collateral debenture 5s	3,951,600	
Five per cent. income bonds	930,500	
Five per cent. income scrip	57,400	
Trust receipts (convertible into 60 per cent. debenture and 15 per cent. income bonds)	10,000	
Total	$5,928,500	
Bills payable		775,860.48
Accounts payable		144,368.16
Coupons unpaid		68,070.00
Coupon interest reserved on 605 Ziegler bonds in litigation		36,300.00
Accrued taxes and miscellaneous interests		12,231.27
Real estate incumbrances		59,388.00
Total		$17,024,717.91

The following comparative statement of earnings and operating expenses was appended to the president's report:

1895.	
Earnings	$517,304.76
Expenses	319,606.29
Net	$197,698.47
Percentage operating expenses to gross earnings	61.78
Daily average passengers	27,223
1896.	
Earnings	$573,668.70
Expenses	339,382.54
Net	$234,286.16
Percentage operating expenses to gross earnings	59.16
Daily average passengers	30,208

Attorney Clarence Knight expressed the opinion that the pending litigation would result favorably and said that action looking toward a final settlement would be taken next month.

Notes on the Use of High-voltage Lamps.[1]

By G. L. Addenbrooke.

As a commencement I may say that the last year's experience has not altered the views expressed in the paper I read before the Institute in March, 1896. The paper was based on the possibility of using lamps of 220 volts, which it was assumed could be got at a certain price, and which would last on the average a certain time. The rest of the paper was occupied with the results which would logically follow from these premises. Now, the opinion of the lampmakers in the discussion was that I had given the lamps a shorter life than they could be made to have, and that I had put a full price on them. Further experience has demonstrated the correctness of their statements. There is no doubt now that the average life of high-voltage lamps is higher than I assumed, and the price is a good deal lower, having been very appreciably reduced in the course of the year for the best lamps. The position of the high-voltage lamp is consequently now even sounder than I ventured to assume it to be then, and the reasons for its adoption are so much the stronger. When my paper was sent in last year, so far as I am aware, with the exception of Bradford and St. Pancras, where Mr. Baynes did his pioneering work, there was not a single central station using publicly high-voltage lamps in Great Britain or the Colonies, though several were experimenting.

What, however, is the position now? Within a few days of sending in my paper Prof. Kennedy's report recommending high-voltage lamps for Edinburg was published—of course, quite independently; and the Westminster company within a month or two followed suit by offering advantages to any of their customers who would adopt the higher voltage. Since then the Kensington & Knightsbridge company have arranged to give any of their customers a reduction of ½d. per unit who will adopt the higher voltage, and they have already a number of such installations. The St. James & Pall Mall company have not actually adopted higher voltage yet, I believe, because their mains are still of such ample section for their load; but they have experimented with it from the first, are strongly convinced of its practicability, and are prepared to adopt it as soon as it suits their purpose. In the provinces, Birkenhead has been carried out on these lines; Chester has just been most successfully opened with a three-wire system and 220-volt lamps; Guildford is following suit; Edinburg and Bradford have already been mentioned. The lamps are supplied at Croydon on an alternating system, and a number of other places are using high-voltage lamps on a smaller scale, but of which I have no definite particulars. In the Colonies, Coolgardie, the central town of the West Australian goldfields, has been lighted with 220-volt lamps for more than six months.

The above is simply a list of towns which I can personally call to mind at the moment as using high-voltage lamps. Were a full list published of all the places where they are installed it would, I believe, create a good deal of surprise. That the movement should have gained such strength within a year is certainly wonderful testimony to its soundness. This year should, however, see a much further expansion for several reasons; the lamps are now cheaper than they were, several firms are supplying them, and nearly all the leading makers of fittings are just putting on the market special holders, cut-outs, ceiling roses and switches adapted for the higher voltage. The extra cost of these special fittings will be only nominal in an installation, while there is no doubt that a good many engineers have hesitated to adopt high-voltage lamps so far because of their doubts as to being able to procure reliable fittings which were not costly and unsightly. When there is also added a year's satisfactory experience to the above reasons I think it is pretty safe to anticipate that high-voltage lamps will be even more in evidence this year than they were last, and that they will gradually become universal on central-station circuits.

As to what the lamps will stand I do not think I can do better than instance Coolgardie, as mentioned above. When asked to act as consulting engineer for this installation about 18 months since I agreed with some trepidation on several accounts, one of which was that the engineer on the spot advised that the only feasible motive power, at any rate for some time, would be oil engines, on account of the scarcity of water. On the other hand, I knew from my experience in similar towns in Australia that to be successful this installation should be simple, free from danger, and should need little regulation. After consultation with several leading firms of lampmakers, I obtained assurances which seemed good enough to commence on, especially as I was not under the necessity of using anything under a 16 candle power lamp; and accordingly a plant suited for 220-volt lamps was designed, and left England in December, 1895, while lighting was commenced last June. As regards the general design of the plant, the description of the recently opened station at Chester seems to concur with it almost identically, except as regards the motive power.

The lamps—220 volts—were procured from the Zurich Incandescence Lamp company. They came to England from Germany, and were transshipped here to West Australia. On arrival there they had a railway journey up the country of 300 miles, the last part of the track having only just been completed by the contractors. Lastly for the final 50 miles or so they had, I believe, to be carted across the open country. I have no actual return of the breakages, but the local manager has made no complaints. The lamps have now been in use six months, partly working from oil engines and partly from a steam engine procured locally to meet the demand till a larger steam plant, now on its way out, could be installed. The regulation, therefore, cannot have been good, as the accumulators sent out had only just been installed at the date of my last advices. In a letter from the manager, however, he characterizes the high-voltage lamp "as the greatest advance in central-station lighting for several years." If, then, high-voltage lamps will satisfactorily stand such treatment as this, it seems clear that there need not be much hesitation in adopting them at home.

I have also found no practical difficulty with the higher voltage in an elaborate house in London where every one of the fittings in the reception rooms were of antique character, and formerly intended for candles or gas, and which the owners insisted on retaining. Some had to be arranged with the five candle power lamps of 66 volts in series, which is from an engineering point of view objectionable, but still they do very well, and the whole installation has a very good appearance; the lamps are evenly incandesced, and I think one sees less of the hairpin effect with the double filament. I mention this to show that it is not only in warehouses and shops that high-voltage lamps can be supplied, but that there need be no fear in introducing them in private houses with the most artistic surroundings.

It may be asked, Is this change to be a final one, or are we to look for lamps being introduced of still larger voltages? Unless a new lamp altogether should come into use, of which there appears no sign at present, I think the voltage to which we now have got will be approximately final for a long time. Lamps up to 250 volts are, indeed, now in the market, and the general pressure for new installations may be gradually raised to this point in time, but the difference between this and 220 volts is not great, and need not cause any hesitation in established stations adopting 200 volts. With nearly 500 volts between the outer wires of a three-wire system, we are fairly approaching the limits of safety for house installations, and this alone is a strong reason for not going further forward. Lastly, the extra precautions and insulation which would have to be adopted with voltages above 500 would go a good way toward discounting any further saving in mains.

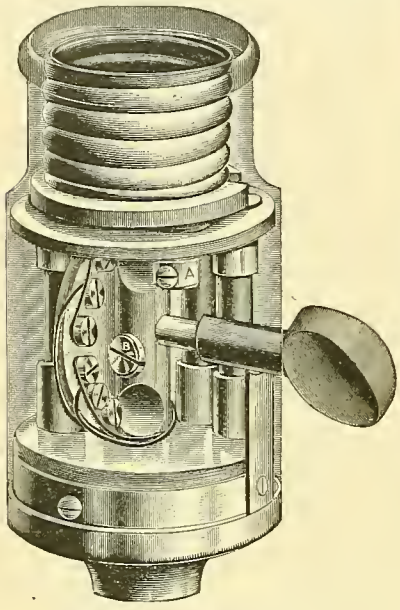
Then again, looking at the subject from another point, we have the adaptability of 500-volt continuous current generators for tramways and power work. No one with any serious experience would, I suppose, attempt to run tramways and lighting off the same circuit, but there is no reason why the generators in the same station should not be employed for both purposes, being coupled to whichever circuit they are needed on. In many cases marked economy would be secured in this way if accumulators were used to a considerable extent for the lighting. In doing this it is necessary, however, to bear in mind

1. From the London *Electrical Engineer*.

that in the future the watt-hours output for tramway and power work will probably in many cases considerably exceed the watt-hours required for lighting. The tramway and power load may, therefore, be the more serious question of the two, and it is likely that if one station is used for all purposes it may be best located where it is most convenient for tramway and power work, the lighting being largely done by accumulators in suitably located sub-stations charged during the night hours or when the tramway or power demand is slack.

Provident Regulating Socket.

The cut shows a socket for incandescent lamps, made by the Pacific Electric company of La Crosse, Wis., and known as the Provident regulating socket, because it enables the lamp to be "turned down," giving five degrees of light. At the point of greatest saving it is said that 69 per cent. of the current used for full candle power is saved, giving a merely perceptible glow of light—enough to enable anyone to see the filament in a dark room and thus readily find the socket. The graduation is effected by simply turning the handle of the switch. The socket is easy to wire, not larger than ordinary non-regulating sockets, and is adapted for direct



PROVIDENT REGULATING SOCKET.

or alternating current. The cut is twice the actual size of the device.

New Flush Plate Switch.

The Perkins solid plate flush switch, illustrated herewith, is claimed to be a decided step ahead of all other switches of the same nature. In Fig. 1 is shown the finished switch in perspective. Fig. 2 is a view from the top, with the plate removed, and Fig. 3 a side view with both plate and enclosing shell removed.

The switch is the well known "Gibbs," and has already spoken for itself, but especial attention is called to the method of mounting it, and to the object attained. The plate is held in position by the switch handle, which obviates the necessity of using disfiguring screws on its surface. The switch handle is made to exert a pressure on the plate just sufficient to hold it firmly in place, and yet not enough to prevent easy operation of the switch in the following manner:

The cast ring, with four projecting ears for receiving the wood screws which hold it to the wall or surface to which it may be required to attach the switch, slips loosely over two posts mounted on the porcelain switch base. The heads of screws in the top of the posts prevent the ring from coming off. Two spiral springs mounted on the posts force the switch from the ring, drawing the switch handle with it and against the flush plate with sufficient force to hold it firmly in position. Rotary motion of the plate is prevented, and the necessity of sinking the ears of the ring into the surface to which the switch is attached obviated by counter-sinking holes for the projecting ears into the lower surface of the plate.

It will be easily understood that the adjustable feature is of great importance where the switches are used in gangs under a single solid plate.

The city of Houston, Texas, proposes the erection of an electric light plant for the purpose of lighting streets and public buildings. B. R. Warner is the city secretary.

Why Electric Railways Increase Slowly in Great Britain.

Elsewhere in this number we have mentioned the fact that a Canadian electrical engineer has been selected to direct the construction work of a large British engineering firm, which is going into electric railway work. It has been surprising to most Canadians and Americans that Great Britain has lagged so far behind us in electric railway work. In Canada alone we have over twenty times the number of miles of electric railway which exist in the British Isles, and we are likely to increase this difference during 1897, and yet no country in the world is so much in need of electric railway development as Great Britain, and no country is better suited to their cheap construction and economical operation, at least in England itself, where there are few mountainous tracts. There are in England hundreds of good-sized towns and villages varying in population from the size of Canadian cities to large towns, which have no railway communication whatever, and the Light Railways Act recently passed affords no adequate solution of the problem of

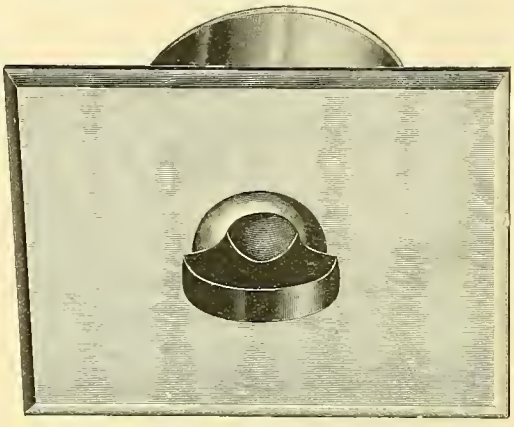


Fig. 1.

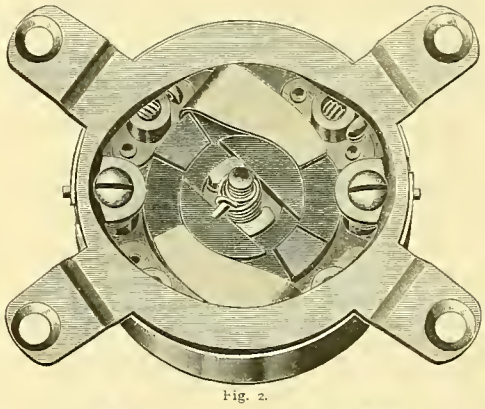


Fig. 2.

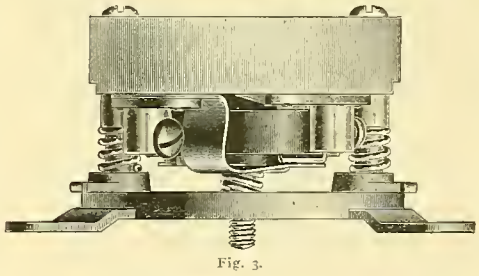


Fig. 3.

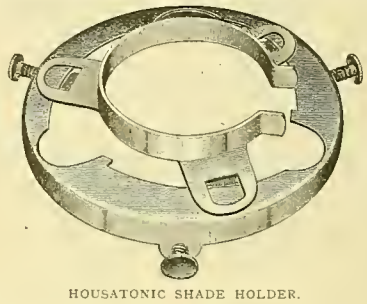
NEW FLUSH PLATE SWITCH.

transportation for these towns, which suffer because of the cost of reaching the markets. No country in the world has better highways than England, and yet the cost of reaching the chief markets of the kingdom is so great that the farmers in many districts are not able to get more than one-half the net prices obtained by their more fortunate neighbors who are near the steam railway system.

Given this condition of things, with such numbers of towns which are still unserved by any sort of railway, it may seem a mystery that Great Britain has done practically nothing in the construction of electric railways. But there is more than one reason to account for it. It is not altogether because of the conservatism of the British people, as many Canadians may suppose, but because of the enormous cost of franchises and rights of way. Canadian cities and towns have rightly encouraged these railways, and many even give bonuses to new ones, but in England municipalities, so far from giving such assistance, are disposed to exact tribute from a new railway corporation. Not only is this the case, but the cost of buying out rights of way and obtaining privileges from private owners is something enormous, and there is great reverence paid to private rights of ownership. To obtain a charter in the first place is no easy matter, for the incorporators have to go to the Imperial Parliament, and those who have ever been through that mill know what an expensive process it is. Hitherto it has been only the wealthy syndicate which could stand this bleeding, but a reformation in this branch of legislation is now in sight, which will make it somewhat easier for construction companies to obtain charters. In the case of the larger cities and towns in England one difficulty also is the congested traffic of many of the narrow thoroughfares, on which it would be impossible to run electric railways at the speed permitted in the wide streets of Canadian cities. These are some of the reasons why electric railway development has been so slow in Great Britain, but it will now begin in earnest, and those who understand the local conditions and can obtain reformations in methods of procedure, will have a great field for their enterprise before them there.—*Canadian Engineer.*

Housatonic Shade Holder.

The Housatonic Manufacturing company of Wallingford, Conn., has completed the shade holder illustrated. The device is carefully adjusted, so that it will fit the various sizes of sockets and still keep the lamp in the center of the shade ring. In appearance it is ornamental and in action it is rapid, simple and practical. It will fit any socket, and, therefore, does away with the necessity of a supply house keeping more than one kind of a shade holder in stock. It is manufactured without the objectionable clamp screw which so often gets lost or fails to catch the thread, and can be detached from any socket instantaneously, only requiring a half turn of the hand. The wedge principle is utilized, so that it is fastened securely and will not become loosened through a jar or usual conditions. It is manufactured so that it



HOUSATONIC SHADE HOLDER.

can be attached to the Edison socket without removing the rubber or porcelain screw on the lower end.

Public Lighting in Dallas, Tex.

At the City Council meeting in Dallas, Texas, on January 12th, the following self-explanatory resolutions were adopted:

WHEREAS, The contract for lighting the city now held by the Dallas Electric company expires November 3d, this year, and as considerable time is necessary to investigate matters connected with same, looking to the betterment and cheapening of said lighting system; therefore be it

Resolved, That the light committee in connection with the city electrician investigate and report to this council at as early a date as possible what, in their opinion, would be the most economical and satisfactory course to pursue and what system of lighting would be the most satisfactory and cheapest for the city to use. Be it further

Resolved, That said committee and electrician investigate the surplus boiler capacity now at Turtle Creek pump house and bring in an estimate on the necessary machinery and construction material for 300 arc lights.

A Very Novel and Beautiful Sight in Huron.

["Special telegram" to the *Chicago Inter Ocean*, from Huron, S. D., dated January 9th, referring to phenomenon of January 4th.]

The atmosphere during the great snow and wind storm on Monday was heavily charged with electricity. Telegraph instruments frequently failed to do the bidding of the operator, and a touch of the stovepipe with an iron poker or other metallic substance would result in sending a sharp current up the arm and thousands of electric sparks into the room. In different parts of the city some queer, yet beautiful, sights were witnessed. The small cottonwood trees in front of the Chicago & Northwestern offices presented a very strange and novel appearance. The trees were buried in snow almost to their tops, but at the end of each twig on every branch in sight was an electrical spark about as large as a common field pea. On taking hold of a twig the spark extinguished, but on withdrawing the hand the spark reappeared. Dispatcher Wilson, who wore a glove with a hole in the thumb, took hold of a twig and the spark transferred itself to his thumb and back to the twig when he let go. There was no shock experienced in handling the twigs, and the light did not waver or tremble, but was quite steady. The trees looked as if a colony of fireflies had settled upon them for the purpose of an illumination. The sight was a very novel and beautiful one.

Possible Competition with the Chicago Edison Company.

About two years ago a great deal of talk was caused by the passage in the Chicago City Council of what were known as the Ogden Gas and Cosmopolitan Electric ordinances. These grants were very broadly and generously worded and were considered very valuable. It was said that they were introduced and passed as "boodle" ordinances, and that they were for sale to the highest bidder, and were not intended to further legitimate business enterprises. However, the courts decided that the Ogden Gas ordinance was legal and valid, in a proceeding brought to test the matter, and this decision is no doubt equally applicable to the Cosmopolitan. The latter gives to the Cosmopolitan Electric company the right to "construct, operate and maintain a plant or plants, and in connection therewith to construct, repair, maintain, operate and use in, through, upon, over and under the streets, avenues, alleys, public ways, tunnels and upon viaducts and under the Chicago River and its branches a line or lines of wire or other electric conductors to be used for the production, transmission and distribution of electricity for the purpose of furnishing light, heat and power, and the transmission of sound and signals or any or either of them."

It was and is difficult to ascertain the names of the backers of the Cosmopolitan company, and nothing was heard of the project, publicly, until recently, when the fact came out that, by permission of the West Side Park Board, the Cosmopolitan company had laid some 40 miles of conduits for electric wires in the West Side boulevards at the same time and in the same trenches as the park commissioners in laying the lighting circuits for the new Garfield Park arc plant. It seems that the ordinance was passed by the commissioners last spring, but it escaped public notice. The president of the board, Harvey T. Weeks, was away at the time, but on his return he discovered the transaction and determined to secure, if possible, some remuneration to the park board for such a valuable concession. The circumstances are set forth in the following communication to the board made by President Weeks after his return to Chicago last September:

Referring to the ordinance passed by this board on the 26th day of May, 1896, authorizing the Cosmopolitan Electric company to lay underground electric conduits in the boulevards under the control of this board, I beg to call your attention to the fact that the conduits of this company have been placed in the trench contracted and paid for by this board and which contain our own electric light conduits; this was done at the time our conduits were laid and by the same contractors, but without authority, either to said contractors or said company, from this board.

I understand that it is the intention of this company to also utilize our manholes, and I therefore accept this opportunity to recommend that before the Cosmopolitan Electric company is permitted to use any of our electric light manholes that it pay to this board the sum of $18 for each and every manhole in our park system into which its conduits extend. I consider this a just and reasonable proposition inasmuch as we have received nothing from this company to assist in paying for excavating the trenches which it has seen fit to use and which it would otherwise have had to excavate and pay for.

Again, the ordinance provides that said company shall at all times place and keep on file at our office plans showing the location of each conduit laid and the number of ducts and wires in each conduit, the location of manholes and other openings to be in access to said conduits, and each cover for such openings shall have thereon the name of said company; but the plans called for have not been furnished. While we have not been put to any additional or extra expense by reason of the placing of the conduits in our trenches, yet the company has saved considerable money by so doing, and I therefore feel that it is only proper that we should receive some remuneration from these people.

The suggestion was acted upon, and a resolution demanding the $18 for each manhole was passed. The sum, when paid, will, the commissioners declare, be about half the cost of the entire work.

The next step was to secure permission from the city Department of Public Works to lay down-town feeder conduits in Washington street, from Halsted street to Michigan avenue, and in Michigan avenue to Jackson street. The plan is said to be to run west in Jackson street to the river, completing a loop on the South Side, from which feeder lines will be constructed. Already the conduits have been laid in Jackson boulevard to the river, and in Washington boulevard to Halsted street, and there are a number of trunk line feeders in the other West Side boulevards. The power house, it is stated, will be at Rockwell and West Van Buren streets. Thus, by using alternating current, the new company can supply current to and through the best part of the West Side to the central business portion of Chicago, penetrating the heart of the territory from which the Chicago Edison company draws its chief revenue.

The application for permission to lay the down-town conduits was made on January 15th, and the plans of the company were then publicly discussed. The permit will undoubtedly be issued on the advice of the corporation counsel, as the decision in relation to the Ogden Gas ordinance seems to give the commissioner of public works no choice. The company's representatives assert that they will begin the work of laying their conduits in the territory covered by the permit at once. Feed lines will be built from the down-town loop, and the heart of the territory covered by the Edison company will be pierced by the Cosmopolitan.

The interests back of the Cosmopolitan Electric company are said to be identical with some of the interests involved in the Ogden Gas company. Back of both concerns, however, it is said there is a great deal of London capital. In fact, it is claimed that half of the money to build both plants has been supplied by London capitalists. The manner in which these two companies have been organized is notable, inasmuch as neither has placed any securities, made any loans, issued any stock or bonds, and yet the plants are being quietly constructed, and the Ogden company is already furnishing gas. The officers of the company claim they are putting in from 50 to 100 meters a day, and will have 5,000 installed within a short time.

There is considerable speculation as to who the persons are that own the half in each company not represented by the English syndicate. The construction of both plants is being done by the Western Republic Construction company, of which Roger C. Sullivan is the head, and beside that little is known of the local backers of the Cosmopolitan company.

Banquet Celebrating the Niagara Falls Transmission.

At the Ellicott Club in Buffalo, on Tuesday of last week, was held the banquet to celebrate the successful transmission of the power of Niagara Falls to Buffalo. About 400 guests were present. Among them were Nikola Tesla of New York, Elihu Thomson of Lynn, Mass., E. J. Houston of Philadelphia, Charles F. Brush of Cleveland, Elisha Gray of Chicago, Charles A. Coffin of Boston, George Westinghouse of Pittsburg, John E. Hudson of Boston, W. J. Johnston, D. O. Mills, Edward A. Adams, Francis Lynde Stetson, Charles Lanier and W. J. Arkel of New York, Enos Barton of Chicago, W. H. Lawrence of Cleveland, Frederic A. Nichols of Toronto, Dr. Louis Duncan of Baltimore, C. A. Cutler of New York, S. Dana Green of Schenectady, Dr. Coleman Sellers of Philadelphia, Joseph Wetzler and T. C. Martin of New York.

Letters of regret were read from President Cleveland, President-elect McKinley, Governor Black and others.

When the menu had been disposed of, Francis Lynde Stetson acted as toastmaster. The toast "The Company" was responded to by Mr. Stetson himself; "Welcome to Buffalo," by Mayor Jewett; "The Empire State," by Controller Roberts; "Electricity," by Nikola Tesla; "The City of Buffalo," by Charles W. Goodyear; "Water Power," by Charles A. Pillsbury of Minneapolis.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 16.—An extensive improvement in the Brooklyn Edison company's service is in view. Contracts have been signed for the sale to the Edison Electric Illuminating company of that city of one of the most valuable shore-front properties in Brooklyn. The price is placed at about $260,000. The property adjoins the piers of the Long Island Railroad company at Sixty-sixth street. It is 260 by 1,150 feet, giving a water frontage of 260 feet, with rights to 550 feet under water and 600 feet back of the bulkhead, taking half of the block from the water front to First avenue. It is the intention of the company as soon as the weather permits to construct a steam plant for generating electricity of an ultimate capacity of 20,000 horse power. There will be erected a one-story brick station 260 by 250 feet, which will have two rooms, a boiler and an engine room, the cost of which will be about $300,000. This plant will be one of the best equipped stations in the country. The system will be underground, doing away with the overhead wires as far as possible. It is the intention to furnish current from this plant as far as Babylon on the south side of Long Island, Roslyn on the north and Garden City and Hempstead in the center. The whole system will be regulated by meter, both for lighting and power.

Speaking of Brooklyn reminds me that Frank Mason's report of a year's work by the police telegraph department of that town was presented to Superintendent McKelvey yesterday. The report shows that the bureau consist of the superintendent, seven operators and four linemen. During the last year a total of 210,030 messages were received at the office. Of this number there were 10,695 calls for the ambulance. The messages actually on the service of the Police Department numbered 162,311. According to the report the department has in use 440 sets of telephones, 500 cells of gravity battery, 35 sets of three and five-carbon battery, 125 cells of Laclanche battery, 500 dry cell battery and 40 cells Gordon and Burnham battery. The patrol box system is now in operation in 18 precincts, with a total of 353 boxes. During the year the metallic circuit system has been completed. Mr Mason has this to say about the efficiency of the work done by it: "In consequence of the introduction of the electric street car (trolley) system on the surface roads throughout the city, the single-wire service in connection with the telephone system of this department was seriously impaired; it therefore became necessary to reconstruct our system and substitute metallic circuits in place of grounded circuits. This change is now complete, and the metallic circuits are now working in a highly satisfactory manner."

Notwithstanding the fact that the Metropolitan company rejected compressed air as the motive power for the new equipment of the Fourth and Sixth avenue lines, the advocates of this system are still abroad in the land. The daily papers report that a company for the promotion of the new power for traction purposes, and for the manufacture of compressed air motor-cars, has been formed. The Compressed Air Power Company is the name of the organization, which has a capital stock of $1,000,000. A certificate showing that one-half of the capital has been paid up was filed last week with the county clerk. The president of the company is Joseph H. Hoadley, and the secretary Almeric H. Paget. The directorate is made up of William C. Whitney, Thomas F. Ryan, William W. Cook, W. L. Elkins and Frederick S. Pearson. The company was formed about six months ago, it is said, and the directors have since then been quietly but actively preparing for carrying out its objects on a large scale. A factory which will be equipped with a complete plant for the construction of compressed-air cars, is being erected at Lenox avenue, and One-hundred-and-forty-sixth street. The buildings have already been roofed in and are to be finished in about two or three months.

The Atlantic Avenue Railroad commission has made its report to Mayor Wurster of Brooklyn. The plan is a most elaborate one, providing for a tunnel under the East river in conjunction with the Long Island Railroad company and a scheme of rapid transit to Jamaica. The commissioners add: "It is also proposed to operate a line of railway by the trolley system on the surface of the streets, thus replacing the existing rapid transit trains by a much more convenient and efficient service for short-distance riders, while at the same time it will distribute the passengers on the through trains to points intermediate between stations, and the through trains will be enabled to give true rapid transit by reason of the few stoppages. The motive power for both systems will be electricity. The through service by short trains at frequent intervals and high speed will give accommodations never before offered. The freedom of this system from the nuisance of noise, smoke, steam and coal gas will do away with many of the objections to former plans for the treatment of this problem."

The Edison Electric Illuminating company of New York has published its annual statement. The report shows a large increase in gross earnings compared with the years 1894 and 1895. The statement, with two years' comparison, is as below:

	1896.	1895.	1894.
Gross earnings	$810,266	$621,149	$421,074
Expenses and taxes	499,266	383,707	234,198
Net earnings	$311,000	$237,442	$186,876
Other income	31,148	29,907	36,539
Total	$342,148	$267,349	$223,406
Deduct—			
Interest on bonds	$ 50,000	$ 33,750	$ 25,000
Dividends (6 per cent.)	225,000	202,500	168,750
Total	$275,000	$236,250	$193,750
Surplus for year	$ 67,148	$ 31,099	$ 29,656

At the meeting the stockholders authorized an increase

in the capital stock of $250,000 and a further issue of $500,000 bonds under the present mortgage. These securities are offered until February 1st at par to the stockholders at the rate of 10 shares of stock and a $1,000 bond for each 150 shares of stock held. The subscriber must take both stock and bonds in equal amounts, payments to be made 20 per cent. at time of subscription, 30 per cent. April 1st, 30 per cent. July 1st and 20 per cent. October 1st.

The Rapid Transit commissioners on Thursday adopted a resolution approving the underground railroad plans of Chief Engineer Parsons—except those of the division between the city hall and the Battery—as already made public. There were only five commissioners present when the members met and, as six votes were necessary for legally approving the plans, the commission adjourned to the mayor's office, and Mayor Strong was asked to join in the action of his fellow-members. The mayor's vote was recorded in favor of the resolution, making the six affirmative votes required. The meeting at the mayor's office lasted only a few minutes. The southern part of the road will not be built unless the property-holders along the route give their acquiesence to the plan and waive the matter of damages. The plan adopted by the commission contemplates a four-track system from the city hall to Forty-second street and Fourth avenue, the the route being along Park Row, Center to New Elm, to Lafayette place, to Eighth street, under Fourth and Park avenues to Forty-second street and the Grand Central Station; then westerly to Broadway and along it to the Boulevard and One-hundred-and-third street, where a division will be made, one branch turning east and going under the Park to One-hundred-and-tenth street and Lexington avenue. The other branch north is from One-hundred-and-third street along the westerly side of the city to the city limits. The general mode of operation is to be by electricity or some other power not requiring combustion within the tunnel or on the viaducts, and the motors must be capable of moving trains at a speed of not less than 40 miles an hour for long distances, exclusive of stops. M. S.

Washington, D. C.

WASHINGTON, January 16.—Owing to the season of the year and to the fact that little construction is going on at the present time, trade matters are exceedingly quiet.

The Potomac Heat & Power company seems to be making the effort of its life. As stated before, this company is in active competition with the United States Electric company, which latter company for a long time has enjoyed a practical monopoly of the electric lighting of Washington. Up to about three weeks ago the fight for privileges was a three-cornered one, but it has now developed a new feature. When the annual contract for furnishing electric light, heat and power to the District was due some time ago, the Potomac company made the lowest bid. But the United States company had all the wires laid, while the Potomac company had not. Then the question of the right of the District commissioners to grant a permit to the Potomac company to lay new conduits was carried into court and decided in their favor. Accordingly the Potomac company was given the contract. Then the matter was carried into Congress and a resolution was introduced by Mr. Cockrell prohibiting the tearing up of the streets until the Senate committee appointed for that purpose had made a thorough examination of the case. But up to date this resolution has not been reached. In the meantime the Potomac company got things ready and on Thursday it proceeded to tear up the streets specified in the contract and lay conduits. This put the Senate appropriations committee into an ugly mood and its members are indignant at what they term a gross violation of their wishes by the District commissioners. The case is an interesting one from the fact that the Senate is evidently anxious to call up or reach the Cockrell resolution before the tearing up proceeds much farther, while the Potomac company is equally anxious to finish the laying of the conduits before the resolution can be reached.

C. A. Lieb, vice-president of the Potomac company, said, when seen Thursday evening: "We are simply working to-night along the avenue between Fifteenth street and Lafayette Park in order to prevent a blockading of traffic at that congested point. We hope to have the street all clear there by 10 o'clock in the morning, and thus avoid any trouble there. That is the only reason we are working to-night. After we pass the car-tracks on Fourteenth street we will work only in the daytime. We cannot go very fast because our terra cotta pipe has not arrived. We have ordered from Canton, Ohio, 400,000 feet of this pipe, and it is on the way now. This is sufficient to lay about seven miles of conduit." When asked if he anticipated a defeat in the Senate, he said he had no idea what the Senate intended to do. "We tried to get a hearing," he said, "but the committtee would not hear us, and they have reported against us without understanding the situation. I cannot say what we will do if the Senate stops the laying of the conduits. We have been to a great expense, and we would probably, in such event, not act until directed by the Senate."

What the members of the Senate appropriations committee think can be judged by the following expression from Senator Cullom: "If I were president I would remove everyone of the commissioners for malfeasance in office. The express purpose seems to be to disregard what they know to be the intention of the appropriation bill. I think their action an outrage upon the city. They are culpable for this tearing up of streets, which the Senate never contemplated would be done." Another senator, in speaking of the same state of affairs, said: "The lighting of the parks was to begin July 1st last, and the commissioners have awarded contracts to a company that cannot begin the fulfillment of them until about eight months have elapsed. In the meantime they are digging up the streets and evenues to the inconvenience of the public, who are obliged to wade through the mud while the work is in progress. The commissioners know that both Senate and House are in favor of a permanent system of subways; they know also that many senators are opposed to the present extension of conduits, and yet I understand that within a few days, since the subject has been agitated before the Senate and senators have spoken their minds freely against the work of the Potomac company, permits have been granted for the laying of conduits along the street for a long distance, paralleling the conduits of the United States company." T. I. P.

PERSONAL.

Frederick B. Smith, vice-president and manager of the Paragon Arc Lamp company, Boston, was in Chicago last week. Mr. Smith is believed to have completed arrangements for a western agency for his product.

Professor Henry A. Rowland, of Johns Hopkins University, has received official notice from the president of the Italian Society of Science, announcing that the Matteucci gold medal has been conferred upon him in honor of his distinguished attainments in physics,

The newly elected officers of the Western Society of Engineers for 1897 are: President, Thomas T. Johnston; first vice-president, Alfred Noble; second vice-president, James J. Reynolds; treasurer, Emil Gerber; trustees, G. A. M. Liljencrantz, Horace E. Horton and Ferdinand Hall.

William H. Sinclaire, formerly president of the Galveston Street Railway company, but more recently connected with the firm of Flynn & Boland, railway brokers and contractors of New York city, died suddenly at Powers Hotel in Rochester, N. Y., on January 11th. Death was caused by apoplexy.

T. C. Rafferty, who is probably one of the best known men in the electrical supply business in the country, is now associated with the Metropolitan Electric company of Chicago, having disposed of all his other electrical interests. All of Mr. Rafferty's friends and customers will undoubtedly be pleased to learn of his new connection, which will afford him ample scope for his energetic work, enabling him to take care of his customers' wants in a befitting manner, and renew old and pleasant trade relations.

ELECTRIC LIGHTING.

John D. Langhorne of Washington, D. C., has bought the Bedford, Va., electric light plant for $10,000.

The Hagerstown, Md., Electric Light company is said to contemplate the erection of a second plant to furnish power to manufacturers.

Mr. Nussbaum will build an electric light plant in Bainbridge, Ga. A 35 to 50 arc and 500 to 750 incandescent system will be installed.

The city council of Cumberland, Md., has passed an ordinance for an election to be held for the purpose of securing a $20,000 electric light plant.

The Gatesville, Texas, Electric Light company has been incorporated, with a capital stock of $25,000, to establish an electric light and power plant.

At Pine Bluff, Ark., the Pine Bluff Power & Transit company has been incorporated, with a capital stock of $100,000 to operate electric light and power plants.

Otto Buchel, William Westhoff, V. B. Proctor and others have incorporated the Buchel Power & Irrigation company at Cuero, Texas, with a capital stock of $50,000 to construct and maintain water and electric power plants, etc.

The Consumers' Electric company has been organized at Bristol, Va., with C. C. Cochran, president; C. L. Sevier, vice-president and Albert Parlett, secretary and treasurer. The company is now erecting an electric light and power plant.

ELECTRIC RAILWAYS.

The Raleigh, N. C., Electric Street Railway company's power plant was recently burned, entailing a loss of $50,000.

The New England Street Railway company of New Haven, Conn., declared a dividend of one per cent., payable January 15th.

It is reported that another effort is being made to consolidate the Enterprise and City railways at Charleston, S. C., and to rebuild them for the use of electric motors.

A scheme is on foot to amalgamate the electric railroads in and around Hamilton, Ont., in which case the Hamilton & Dundas road will be converted into an electric line and extended to Galt, while the Radial railway will be extended to Oakville and later to Mimico.

The annual report of the Rochester Railway company shows the following: Gross earnings from operation, $70,999.51; operating expenses, $42,626.20; net earnings from operation, $28,373.31; income from other sources, $710.22; gross income from all sources, $29,083.52; interest on funded debt and taxes, $26,193 03; net divisible income, $2,890.50.

John D. DeGoiley of Mt. Gilead and William Nicholson of Ashley, O., are interested in the proposed electric road from Mt. Vernon to Richmond, known as the Ashley, Mt. Vernon & Richmond electric railway. The length of the proposed line is 50 miles, running through a thickly settled country and crossing the seven railroads which run north and south. No construction work has as yet been done.

The Columbus Street Railway company has declared a dividend of one per cent., payable February 1st. The company reports gross earnings for December of $52,523, a decrease of $2,885 as compared with the same month of the previous year, and net $26,544, a decrease of $1,594. For the year ended December 31st the gross earnings were $631,623, an increase of $1,328 as compared with the corresponding period of the previous year, and net $322,879, an increase of $4,478.

TELEPHONE.

The Missouri Telephone Manufacturing company of St. Louis is just completing extensive toll lines through the central portion of Tennessee connecting all the different towns to Johnsonville and Britts Landing. This is said to be one of the largest toll-line systems ever built in this country.

It is stated that the telephone bill in the Michigan Legislature will be fiercely fought by the Bell interests, as it contemplates making the Bell company do business for and with the numerous independent lines which have sprung up all over the state, and whose business is seriously hampered by their inability to give satisfactory state-line service because of the refusal of the Bell company to do business with them.

MISCELLANEOUS.

Bids will be received by the Board of Commissioners of the county of Allen at Fort Wayne, Ind., at 2 o'clock, February 25th, for a new power house and equipment for heating and lighting plant.

The University of Idaho, at Moscow, Idaho, offers a four years' course in engineering. F. B. Gault, the president, will furnish information to those who desire it. Tuition is free to persons who have resided in Idaho for 12 months prior to enrollment.

J. Glen Wray is announced to deliver an address on "Transmission of Electrical Energy," in the lecture room of the Chicago School of Electricity, 335 Dearborn street, on January 21st, beginning at 8 P. M. This is the nineteenth in the series of "practical talks" given by the school.

On the new British warship Prince George six searchlights are carried, and the interior lighting is effected by 930 incandescent lamps, one-third of which are 50 candle power lamps and the remainder 16 candle power. There are 29 miles of electric light cable aboard the Prince George. Electricity is also employed as an auxiliary in training the four 12-inch guns, but apparently is not made use of to drive ventilators or to hoist shot and shell. Current is supplied by three 600-ampere dynamos.

The production of copper in the United States in 1896 showed a large increase, although the consumption decreased on account of the general depression of business and the comparatively light demand from the electrical and other interests. The total output, as given in the *Mineral Industry* for 1895, was 386,453,850 pounds, or 172,524 long tons. For 1896, estimating the month of December, there was a production of 453,913,600 pounds, or 202,640 long tons, showing an approximate gain last year of 67,459,750 pounds, or 17.5 per cent. The production in 1896 was by far the largest ever reported. The increase came largely from the Montana mines, which have made a very large output, the Anaconda alone turning out over 115,000,000 pounds. The Michigan mines maintained about their usual output.

TRADE NEWS.

The headquarters of the Wagner Electric Manufacturing company of St. Louis at the convention of the Northwestern Electrical association will be at the Pfister Hotel.

Jas. C. Wormley & Co., Marquette building, Chicago, are making some flattering inducements to prospective incandescent lamp buyers. For 30 days they will allow a discount of 10 per cent. on current lamp prices. Mr. Wormley will be at the Milwaukee convention.

The Chicago Electric Commission company of 169 Adams street, Chicago, has issued its first "price-current"—a four-page sheet of electrical bargains in machinery and supplies. The company acts as selling agent for buyer and seller, charging a small commission for its work. It deals largely in second-hand apparatus.

The contract for the complete rolling stock of the Quebec electric railway, including cars, motors, etc., has been awarded to Ahearn & Soper of Ottawa, Ont. The system will be as nearly as possible a duplicate of that at Ottawa, which is recognized as a model. The motors used will be of Westinghouse make, and will be especially adapted for the grades which exist at Quebec.

The Electric Appliance company can tell an amusing story of the enthusiasm of a contractor over his first job with Armorite conduit. It certainly is a pleasure to a contractor to be able to draw the wire into the tube without the use of soapstone and other lubricants. The lining of the Armorite tube offers almost no resistance to the passage of the wire, and the wire slips through the conduit with remarkable ease.

The Chicago Armature company, 14 and 16 North Canal street, has recently been reorganized and is now under the management of the following-named officers: President and treasurer, U. L. Swingley; manager, Wm. Wright; secretary, E. B. Bronson. The company is in better shape than ever before to make and repair commutators and armatures for any system. The company also makes a specialty of general electrical repairing and offers special discounts to prospective customers.

Alfred F. Moore, who for so many years has been known in the electrical trade as the manufacturer of electric light, telegraph and telephone wires and cables, has issued a large office calendar for distribution to friends. This concern was established in 1820, and is one of the solid firms in the electrical business. Its trade has shown a large increase, it is reported, during the last year. Alfred F. Moore, Chas. C. King and Antoine Bourcoonville comprise one of the strongest and most pushing organizations in the electrical trade, and their success is merited.

A. O. Schoonmaker, importer of mica at 158 William street, New York, calls attention in a recent circular to the superiority of East India mica, which he handles in the solid sheet as it is mined. He says: "The mica I sell comes direct from the original sources in India. It is selected stock of guaranteed purity, and no region in the world furnishes a better article for insulating purposes. It is perfectly free from iron, thus rendering its non-conducting properties of the very highest order. It splits even throughout and has a uniform, smooth cleavage. This mica has been used constantly by many of the largest and most prominent electrical companies in the country, and has given perfect satisfaction. It is always reliable."

The merits of the widely known Card motor are well established, and the generator manufactured by the same company has also an excellent reputation. As the company says, in introducing "A Few Testimonials" recently published, "the excellence of the apparatus and the success achieved by the Card Electric company is so well known that it seems almost unnecessary to publish commendations." However, the letters showing the varied uses to which the apparatus is put are interesting, and from the character and standing of the writers should have great weight with intending purchasers of electrical machinery. A report of very satisfactory tests of the company's automatic motor switch at Armour Institute is also given in the pamphlet. The Card Electric company is addressed at Mansfield, Ohio.

K. McLennan & Co., sole manufacturers of Gale's commutator compound, extend a cordial invitation to all members of the Northwestern Electrical association who have not as yet tried Gale's commutator compound to write to them to their office, 1128 Marquette building, Chicago, for a free sample stick. Gale's commutator compound, it is said, will absolutely prevent sparking and cutting of commutators and not gum the brushes. This compound has been adopted, it is claimed, by nearly three-fourths of the electric power plants and central stations in the United States and Canada and also by many foreign power plants and stations. It is the desire of the manufacturers to have their compound used in every electric plant in the country. A free sample stick may be had, also, of every supply house where the compound is sold.

The Germania Printing company of Milwaukee, Wis., has completed its new eight-story block, which is to be devoted to printing and bookbinding industries. The entire outfit of machinery is to be electrically driven by direct-connected motors. The contract for this work has been awarded to the Northern Electrical Manufacturing company of Madison, Wis., which is building slow-speed steel-clad motors especially designed for this class of work. There were 32 bids upon the job, and the award of this large order to the Northern company is a high tribute to the many valuable features of its electrical machinery. The Northern company is said to be backed by large capital and it is certainly pushing for business most aggressively.

BUSINESS.

Lindsley Bros. of Menominee, Mich., have ready for shipment on short notice 15,000 cedar poles, ranging from 25 to 60 feet in length.

A. O. Schoonmaker, the New York mica dealer, has opened a Chicago office at 1563 Monadnock building. John Child is in charge, and he will carry a full line of all grades of mica for prompt shipment.

The Armorite Interior Conduit company of Detroit has just issued a reduced price-list showing lower rates for its conduit. Trade is reported to be booming, several large contracts having been closed recently.

One of the special features of the business of the Philadelphia Engineering Works is the manufacture and erection of steel plate chimneys for steam power plants. A catalogue is devoted entirely to this work, and it should be of value to engineers.

William C. MacCurdy, late of the firm of MacCurdy & Smith of Indianapolis, has opened an office at Room 42 Baldwin block in that city, as an electrical engineer and manufacturers' agent. He has already secured several good agencies and is looking forward to a betterment in the electrical business.

The Puritan Electric company is presenting a beautiful calendar illustrating the times when conditions about Boston were different than at present. The Puritan Electric company, whose main office is at 178 Devonshire street, Boston, reports many inquiries regarding its enclosed arc lamp, and the orders for sample lamps have been gratifying in number.

Rainbow packing is a commodity which is becoming identified with the electrical business. It is used for steam joints and is not affected by oils and alkalies. The trade-mark has the word "Rainbow" in a diamond in black, and it does not seem that there has been any imitations. The Peerless Rubber Manufacturing company of 16 Warren street, New York, is kept busy taking care of orders which have been sent in for the celebrated Rainbow packing.

Edward K. Patton, for many years connected with the Perkins Electric Switch Manufacturing company, Hartford, Conn., has recently been appointed Chicago agent for this well-known company. Mr. Patton's long and favorable connection with the electrical business should enable him to handle the large western trade of the Perkins company with the best of satisfaction. The Chicago office remains at 1538 Monadnock block.

The Manhattan General Construction company is sending out a new catalogue, in addition to the one recently mailed to its friends, which is as beautiful a piece of work as the previous one, and illustrates many points in detail of the Manhattan lamp. This company's calendar is also a work of art, and it reports that the applications for these have nearly exhausted the stock, but that it will endeavor to accommodate any who desire the calendar, as a new edition has been ordered.

A. L. Bogart of 22 Union Square, New York, issues a catalogue which shows the latest novelties in electric gas lighting apparatus. Probably the newest feature which Mr. Bogart has brought out is the Welshach electric gas lighting device, which is illustrated in this catalogue, and for which there will, without doubt, be a large demand. His Rhumkorff induction coils are especially constructed for use in electric gas lighting, and are arranged for this class of work, and can be operated by open circuit battery when desired. The dynamo electric lighter has many special features, and the new "Vim" dry battery is illustrated.

The Williams & Abbott Electric company and the Kirk-Latty Manufacturing company, both of Cleveland, Ohio, have consolidated, and hereafter the latter, the Kirk-Latty Manufacturing company, will be the sole manufacturer of both companies' lines. It will also manufacture, and be in position to furnish, a full line of magneto bells, switchboards, telephone receivers, telephone supplies, together with other electrical and mechanical devices. The company is building a new and large factory, and is equipping it with modern machinery and appliances, and will have facilities for turning out these goods in large quantities. It will aim to increase the quality of the goods, if possible, and will carry a large and well assorted stock.

The Ward Leonard Electric company of Hoboken, N. J., has secured the exclusive right to the manufacture and sale of the various types of outlet boxes, switch boxes, junction boxes, floor boxes, cable boxes, drop cord boxes, receptacle boxes, etc., which have been known to the trade as the Mailloux, De Rycke, Krantz, Fountain and Soons boxes, and is supplying these boxes porcelain-lined instead of paint-lined as heretofore, the prices being in all cases equally as low and in many cases much lower. The porcelain lining makes a good insulation for the purpose, as it is unaffected by heat, cold, acids, alkalies, oils, or in fact any chemicals or conditions met with in practice. The insulation is guaranteed to measure over ten megohms and to resist 2,000 volts alternating electromotive force.

One of the busiest houses in Chicago at the present time is the Farr Telephone & Construction Supply company, 342 Dearborn street. The company handles everything in the telephone and construction line, from the smallest article in the supply trade to a complete telephone exchange. The Farr company has made an excellent reputation within the last six years and has an established trade which covers the entire United States as well as quite a few foreign countries. The company is particularly noted for its promptness in filling orders, although at the present time it is a hard task to maintain this reputation, as the many orders received within the last few months have kept the entire force unusually busy. Users of telephones and supplies will do well to correspond with the Farr company when in need of such material.

A flattering testimonial to the value of micanite as an insulator comes from Superintendent H. S. Cooper of the Schenectady (N. Y.) Railway company, who writes to the Mica Insulator company of New York as follows: "In March, 1894, you put a full body and slot insulation of micanite on one of our Edison No. 16 street-car armatures, and the same was wound at once and put in service and has been pretty steadily running ever since, the car having made over 50,000 miles. The armature has never given us any trouble in 'body grounds' since it started, although it is of the 'ring' type and is not protected by the motor frame, it being open to snow, slush or water from the wheels. The wiring on this armature has just been burned out by a severe and continued overload, so heavy as to not only char the insulation of the wire, but to melt some of the wires themselves. On stripping off the wires we were surprised to find the insulation of body and slots in apparently good order; and after fully stripping and testing we find it absolutely perfect mechanically and electrically and are now rewinding it, having done nothing to the insulation but to give it a coat of varnish and bake it. We consider this so remarkable a record that we think it only justice to you to inform you of it. While the full micanite body insulation costs several times more than our previous method of cloth, mica and paper, the results in freedom from armature 'body grounds,' and the ability to re-use the insulation indefinitely, are points that will make us consider the use of micanite as essential in all our work for the future."

The Ball Engine company of Erie, Pa., reports the following shipments during the last 30 days: Shoenberger Steel company, Pittsburg, Pa., one 150 horse power vertical direct-connected and one 400 horse power vertical direct-connected engine; Chicago Public Library, Chicago, Ill., four 200 horse power vertical cross-compound and one 100 horse power vertical cross-compound engine; Nicopol-Mariopol Mining & Metallurgical company, Mariopol, Russia, one 400 horse power vertical cross-compound engine, direct-connected; to Mexico, five 25 horse power engines; Jackson Street Railway company, Jackson, Tenn., two 175 horse power engines; Electric Installation company, Geneva, Ill., one 100 horse power and one 70 horse power engine; Hammond Building, Detroit, Mich., two 70 horse power engines, direct-connected; United Coke & Gas company, Glassport, Pa., one 60 horse power engine; Paul O. Steinland Building, Chicago, one 125 horse power engine, direct-connected; Crook, Horner & Co., Baltimore, Md., one 50 horse power engine, direct-connected; Church Home and Infirmary, Baltimore, Md., one 60 horse power direct-connected engine; Pine Ridge Indian reservation, one 35 horse power engine, direct-connected; Rosebud Indian reservation, one 35 horse power engine, direct-connected; Pennsylvania Tube Works, Pittsburg, Pa., one 60 horse power engine, Juniatuski Leather company, Waynesville, N. C., one 50 horse power engine; Wauwatosa County Insane Asylum, Wauwatosa, Wis., one 70 horse power and one 110 horse power engine; A. M. Fuller Building, Chicago, one 70 horse power engine.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued January 12, 1897.

574,885. Controller for Electric Motors. Harry P. Davis, Pittsburg, Pa. Application filed December 3, 1895.

This device includes the combination with circumferentially arranged sets of stationary contact blocks or pieces, and a centrally mounted head movable a limited distance from neutral position in either direction, and having radial arms provided with contacts at their outer ends electrically connected in pairs, of a plurality of resistances, each permanently connected to two sets of contact blocks.

574,889. Electric Cigar Lighter. John W. Dawson, Louisville, Ky. Application filed August 17, 1895.

A cigar-cutting apparatus with an incandescent lamp is constructed so that by the movement of the handle the lamp and the lighting device are energized and the cutter is operated.

574,896. Combined Rheostat and Reversing Switch. Jonathan P. B. Fiske and Charles P. Smith, Alliance, Ohio. Application filed March 18, 1895.

The reversing switch and lever for operating or throwing the same, and a segment gear with curved ends or stops moved by the lever, and a rheostat or variable resistance in gear therewith are provided.

574,901. Telephone. Claude C. Gould, Philadelphia, Pa. Application filed April 29, 1895.

One claim follows: The combination in a telephone of a casing or housing, a diaphragm, a rolling electrode, a basket for said electrode, and a yoke attached to said casing and basket.

574,903. Electric Meter. Johannes Hessberger, Niedersedlitz, Germany. Application filed August 10, 1895.

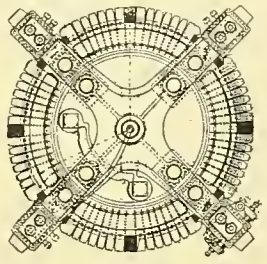
Means are employed for producing a magnetic field and a bismuth or bismuth alloy conductor in the field, one of the parts being movable in relation to the other.

574,905. Electric Arc Lamp. Ralph O. Hood, Danvers, Mass. Application filed July 6, 1896.

In an electric arc lamp there is the combination of a mass whose expansion under the action of the electric current separates the carbons employed therein, and a magnet in series with the arc for feeding the carbons toward each other when the current flowing across the arc is at a predetermined value.

574,914. Means for Adjusting Compound Wound Dynamos. Benjamin G. Lamme, Pittsburg, Pa. Application filed December 28, 1893.

The method of adjusting the compounding or series coil of a compound wound dynamo consists in varying its compounding effect while maintaining a constant resistance between its terminals.



NO. 574,885.

574,922. Electric Calendar Clock. George W. MacKenzie, Beaver, Pa. Application filed December 28, 1895.

An electrically actuated reciprocating bar is mounted in guides; an inclined-faced pawl is pivotally secured to the top of such bar, provided with a tail-piece and an adjustable stop secured on the guide-frame and designed to engage the tail-piece and return the pawl to a normal position.

574,926. Overhead Electrical Knife Switch. Joseph Meechen, Kansas City, Mo. Application filed February 25, 1896.

An overhead switch comprises an insulating base, knife terminal jaws and standards depending therefrom, an insulating reciprocatory cross-head upon the standards, contact knives carried by the cross-head and provided with pivoted terminals, and springs normally pressing the cross-head elevated and the terminals with a yielding pressure into frictional engagement with the knife-terminal jaws.

574,953. Electrical Signal System. Robert Skeen, Madison, Ill. Application filed March 4, 1895.

A system is described comprising an electric railroad provided with a trolley wire for supplying current thereto, having an insulated section, a switch for cutting off the current from the section, and a railroad crossing the former road, the one end of the insulated section terminating substantially at the crossing road, and a live wire over the electric road in addition to the insulated section.

574,954. Electric Signal. Robert Skeen, Madison, Ill. Application filed May 11, 1895.

An electric cut-out is claimed, comprising a rotatable or oscillating piece, having a crank, operative means, a connection of variable length between the crank and operative means, and a stop adapted to engage laterally with the connection in an extreme position of the same.

574,965. Vacuum Dispatch System. James A. Watson, Washington, D. C. Application filed February 18, 1893.

In a dispatch system there is the combination of a normally closed and exhausted tube, a carrier movable within the tube, and exhausting mechanism to constantly maintain a vacuum within the tube.

574,978. System of Lightning Protection for Electric Circuits. Alexander J. Wurts, Pittsburg, Pa. Application filed July 19, 1893.

One claim is reproduced: In a system of electrical distribution, the combination with a source of current and translating devices, of a line circuit provided at suitable intervals with ungrounded inductive resistances, said resistances serving to dissipate static charges by transforming their energy into heat.

574,979. Device for Protecting Electric Circuits. Alexander J. Wurts, Pittsburg, Pa. Application filed October 2, 1895.

A choke-coil is provided with a conducting piece or strip located adjacent to but not in contact with several of the turns thereof, whereby spark-gaps are formed between the turns and the strip.

574,994. Printing Telegraph. Bernhard Hoffmann, Paris, France. Application filed July 17, 1895. Patented in France December 1, 1894.

A type-wheel, escapement and revolving brush are connected together, a dial of segments traversed by the brush, keys connected to the segments, normally alternately grounded and open-circuited, and each adapted to establish the reverse condition when depressed, a line connection from the brush through a line battery to line, a relay in the line connection, an escapement magnet controlling the escapement, a printing magnet and a commutator which in the "receiving" position grounds the line through the relay, and in the "transmitting" position grounds the line through relay, the line battery, brush, segments and keys.

575,002. Illuminant for Incandescent Lamps. Alexander de Lodyguine, Pittsburg, Pa. Application filed January 4, 1893.

An incandescing illuminant for electric lamps is composed of an incandescing metallic body, and containing a conducting fillet of different material.

575,045. Electric Valve Apparatus. John V. Stout, Easton, Pa. Application filed June 7, 1892.

One claim is given: In a valve device the combination with the bonnet, of a frame mounted thereon and supporting the magnets, uprights attached to the frame, a cross-piece connected to the uprights and forming a guide for the valve stem, armature levers connected to the uprights and carrying the contacts, one of the levers acting as a lock for the other, and connections between the latter lever and the valve stem.

575,047. Electric Quick-break Switch. Arakelyan H. Armen, Philadelphia, Pa. Application filed March 30, 1896.

In an electric quick-break switch the combination of a switch lever and push-button working in planes perpendicular to each other, with a button-arm auxiliary to the button and a spring working between the switch-lever and button-arm.

575,053. Electric Railway. Léon Dion, Natick, Mass. Application filed December 30, 1895.

A closed tube or conduit in sections insulated from each other, with magnets therein attached to the top of the tube or conduit, in combination with a non-magnetic main conductor, and an auxiliary magnetic conductor superimposed thereon, the magnets lifting the auxiliary conductor.

575,054. Electrical Propulsion for Railway Cars. Léon Dion, Natick, Mass. Application filed February 27, 1896.

In an electric railway system a closed conduit, a helical flexible auxiliary electrical conductor therein, in combination with a main electrical conductor having a concaved groove along its upper surface.

575,059. Bicycle Electric Bell. Herbert B. Ewhank, Jr., Baltimore, Md. Application filed May 18, 1896.

The special feature of this arrangement is a supporting device for a bell and electric battery, comprising a plate having a pocket, a hook which takes over the handle-bar, and a clip which clamps around the post; an electric battery supported in the pocket, an electro-magnetic bell supported on the hook, and a make-and-break device in circuit with the battery and bell.

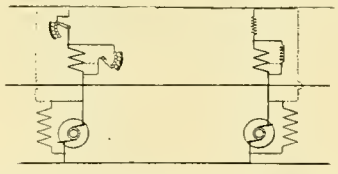
575,072. Electrically Operated Piano Attachment. Ernest J. Simpkins, Toledo, Ohio. Application filed December 26, 1895.

Electric means are employed for separably actuating the different keys thereof, a music sheet or strip, sheet-controlled circuit closers determining the operation of the keys, a resistance and a double-actuating sheet-controlled cut-out device operating independently of the circuit closers to include the resistance in or exclude it from the circuit.

575,080. Trolley Head for Electric Cars. William S. Troutwine, Indianapolis, Ind. Application filed May 22, 1896.

The combination is described with a trolley-head, having the inside notches of the scraper, having its end inserted in the notches in the trolley-head and secured in the head by means of the axle on which the trolley-wheel ordinarily is mounted, the scraper having an upwardly projected portion extending beyond the trolley-head into contact with the wire, and terminating with a hollow or notch to keep the scraper on the wire.

575,099. Trolley Stand. John E. Bishop, Indianapolis, Ind. Application filed August 22, 1896.



NO. 574,914.

This device is composed of a base-plate, having a vertically disposed pivot post and an integral annularly bored bearing-cup disposed at the lower end of and surrounding the post, bearing-balls arranged in the cup, a swivel head longitudinally bored to loosely fit the pivot-post, and provided at its lower end with an integral depending bearing cone turning inside of the circle of the lower set of bearing-balls, and at its upper end provided with an annular rounded recess forming a ball-cup, bearing-balls arranged in the ball-cup of the swivel-head, a cap-plate adjustably fitted on the upper end of the pivot-post and provided with a central depending bearing cone working inside of the circle of the upper set of balls, wear-bushings facing the ball-cups and bearing cones, a trolley pole having a yoke pivotally embracing the swivel-head, and oppositely arranged spring-adjusted bars carried by the swivel-head and having connections with the yoke.

575,116. Direct Current Dynamo-electric Machine. Maurice Hutin and Maurice Leblanc, Paris, France. Application filed February 12, 1894. Patentented in France June 29, 1893, and in England December 4, 1893.

A multipolar continuous current dynamo-electric machine of the closed circuit armature type is provided with a commutator having a lesser number of segments than there are armature sections, and means for rotating the commutator at a proportionately higher speed than the rotor.

575,131. Signaling Appliance for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed November 4, 1895.

One claim is for the combination with a plug circuit, a calling key in the plug circuit, and a generator of signaling current having the terminals of its armature connected with switch contacts of the calling key, of a ground connection to the middle point of the active wire of the armature.

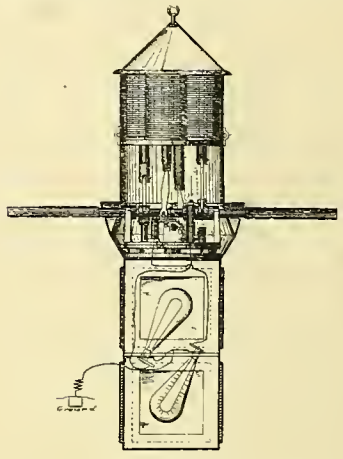
575,156. Electric Bell. John W. Holdsworth, St. Louis, Mo. Application filed April 9, 1896.

There is a fixed electro-magnet, comprising a bobbin and core, and a movable electro-magnet comprising a bobbin mounted upon a vibrating core, arranged parallel respectively to the fixed bobbin and core, and having both the poles of the vibrating core arranged in magnetic relation to the poles of the fixed core of opposite sign, lateral extensions being provided on both the poles of one of the cores and at right angles thereto, so as to bridge the space by which the cores are held apart by the bobbins and bring the cores in contacting relation, and thus close the magnetic circuit between them.

575,170. Electric Conductor. Herbert T. Richards, Brooklyn, N. Y. Application filed November 20, 1896.

An insulated conductor is provided with a marker occurring at periodic intervals throughout its length, and projecting from the surface, by which its identity may be recognized.

575,186. Telephone System. John H. Weckel, Breakabeen, N. Y. Application filed March 7, 1896.



NO. 574,954.

In this system the feature is the combination with a main line, including in its circuit a plurality of stations, each having a transmitting and receiving apparatus and a signal, of a central office normally in the circuit of the main line through the medium of a switchboard, a supplemental signal at the central office connected with the switchboard, and one or more side lines normally in circuit with the signal through the medium of the switchboard, the switchboard being adapted to throw the side line into circuit with one section of the main line, and at the same time to throw the remainder of the main line into circuit with the supplemental signal.

575,210. Dynamo-electric Machine. George L. Campbell, Kinsman, Ohio. Application filed October 8, 1895.

The combination is claimed of the armature, field magnet supports movable toward and from the armature, field magnets mounted to move with the supports and pivoted thereto to swing in planes extending longitudinally of the armature, and means for holding the field magnets in position.

575,231. Static Generator. Augustus J. Gawne, Sandusky, Ohio. Application filed October 10, 1896.

There is the combination with the oppositely rotating disks, the metal plates secured thereto and the brush-holders connected with the apparatus by telescoping or sliding joints or connections, whereby the brushes may be given longitudinal or radial adjustment of the laterally movable tubular arm, the current collectors connected therewith, and the terminals having stems engaging with the ends of the arm.

575,235. Electric Current Regulator. William Hawker, Windsor Mills, Canada. Application filed September 25, 1896.

This regulator comprises a pair of resistance coils, lead-wires having shunt connections with one end of the coils, a pair of contact plates with which the lead-wires connect, pairs of contact-plates having shunt wire connections with the coils at different points of their length, a pair of contact-plates common to all the other pairs of contact-plates, and adapted for connection with a lamp or other device, a block carrying contacts for connecting the last-named contact-plates with either single pair of the first-named contact plates, and a screw shaft for moving the block.

575,303. Electric Railway. George W. C. Lomb, Birmingham, Ala. Application filed February 18, 1895.

An electric conductor and insulating envelope inclosing it with contact-making pieces are employed, and a continuous hanger for holding the conductor and its insulating envelope and trolley wheel, having a middle portion of conducting material in contact with the envelope, and provided with flanges of insulated material embracing the hanger riding upon and guided thereby.

575,314. Electric Locomotive. William L. Silvey, Dayton, Ohio. Application filed November 7, 1895.

An electric motor is mounted on the truck, and a gear wheel is rigidly secured on one of the axles, with a pinion shaft flexibly coupled to the motor shaft, and a pinion carried by the pinion shaft and in mesh with the gear wheel; a gear frame affording bearing for the pinion shaft and including casings for the gear wheel and shaft coupling, the frame having at its outer end two points of support on the axle, its inner end being yieldingly suspended at a single point through pivotal connection with a cross-beam of the truck frame, the connection comprising a stud and a bearing therefor, the bearing being below and in vertical alignment with the motor shaft.

Western Electrician.

EVERY SATURDAY.

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Northwestern Electrical Association.

An enthusiastic gathering of electrical men assembled at the Hotel Pfister, Milwaukee, January 22d, to attend the fifth annual meeting of the Northwestern Electrical association. The convention lasted three days and the meetings attracted many residents of Milwaukee who were not directly engaged in the electrical business. Several papers of unusual interest were read and some of them provoked a lively discussion. The insurance problem was one of these, and Mr McLaren's paper served its purpose in bringing out the views of the members. Another topic of interest was the question of municipal ownership, to the consideration of which much time was devoted. Surprise was manifested at the action of the National Electric Light association in practically refusing to act in concert with the Northwestern association.

NORTHWESTERN ELECTRICAL ASSOCIATION.—DELEGATES TO THE MILWAUKEE CONVENTION.

In the press of business social features were not overlooked altogether, and the members had a very enjoyable time as well as a profitable meeting.

The convention was called to order at 11:40 Wednesday morning, January 20th, by H. C. Higgins, second vice-president. The secretary read a telegram from President Baker stating that illness prevented his attendance at the convention.

The annual report of the secretary was then read, and John Schuette of Manitowoc moved that it be adopted. P. Norcross of Janesville added:

While I desire to second the motion of Mr. Schuette, I think it is hardly a sufficient indication of the appreciation which I know the association feels for the work of the present secretary. He has just presented one of the best reports we ever had, and while I second the motion with pleasure, I think we ought also to express our appreciation of the excellent work done for the association by its present secretary, Thomas R. Mercein.

The motion was unanimously carried.

T. F. Grover, chairman of the entertainment committee, announced the arrangements made by his committees, including a banquet at the Pfister and a theater party at the Alhambra.

The secretary read 28 applications for membership in the association, all of which were accepted.

Messrs. Debell, Copeland and Hanley were appointed a committee on adjustment of the question of the secretary's salary. Later the committee recommended that the salary of the secretary for the ensuing year be fixed at $150 and that $50 in addition to that amount be allowed as extra compensation for the last year's work. The committee said:

We deem that $150 really is not as much as the work is worth, but we think for the coming year it is as much as the association can well afford, and we think the work done in the past year deserves a great deal more compensation than has been allowed for it up to the present time, and that is why we recommend that $50 be allowed for last year's work, and that the salary for the coming year be $150.

A motion was unanimously carried that the report of the committee be adopted.

F. S. Terry of Chicago read the first paper of the meeting on the subject of "Incandescent Lights," for which a vote of thanks of the association was unanimously tendered.

The secretary announced that the association had received a letter from A. Weller, local manager of the Western Union Telegraph company, placing a uniformed messenger boy at the service of the association.

The afternoon session was called to order at 3:50 P.M. Two applications for membership were favorably acted upon.

A paper was read by H. C. Wirt of Schenectady, on the subject of "Protective Devices for Transformers." The thanks of the association were tendered Mr. Wirt for his very interesting contribution and a general discussion followed.

The subject of the next paper was "Insurance as Affected by Electrical Construction." It was read by George S. McLaren of Milwaukee, and upon motion by Mr. Bean a vote of thanks was tendered him.

Mr. Kountz presented an amendment to section 3 of article 7 of the by-laws, providing that "the secretary shall drop from the roll the name of any member who shall be in arrears for one year's dues."

It was decided that the statistics obtained from the various central stations be printed in pamphlet form and a copy sent to each central station that had furnished the information and to each member of the association, without names, but with a key. It was suggested, however, by Mr. Hanley that the secretary defer printing the report for 30 days, and that in the meantime he notify such central station men as have not answered the questions heretofore referred to, what the intention of the association is, and to ask them to furnish the desired information.

The subject of municipal ownership then came up. Mr. Doherty of Madison presented a preliminary report and explained the work of the committee. He related the experience of the association in its efforts to secure an arrangement with the National Electric Light association, under which both organizations could work together. This was followed by a report from Mr. Colman and a general discussion in which several members participated. Finally, the matter of the report of the committee was referred to the directors with power to authorize and furnish means for the committee to carry on the work on the lines that it had been following.

An evening session was held at which Caryl D. Has-

kins of Boston presented a paper on and gave a demonstration of "Röntgen Ray Phenomena."

Thursday's session was opened at 10:30 A. M., and Mr. Pierce of Negaunee was requested to address the convention on the subject of the municipal lighting plant at Negaunee. Mr. Schuette of Manitowoc addressed the convention on the defects and dangers of municipal ownership and related his own experience.

The next order of business was the election of officers for the ensuing year, the following-named gentlemen being chosen

President, H. C. Higgins, Marinette, Wis.; first vice-president, G. L. Cole, Beloit, Wis.; second vice-president, J. H. Harding, La Porte, Ind.; secretary and treasurer, Thomas R. Mercien, Milwaukee, Wis.; directors, Messrs Debell, Sheboygan; Rau, Milwaukee; Bean, St. Joseph.

At the conclusion of this business, and after the gentlemen selected had expressed their thanks for the honor conferred upon them, Prof. W. M. Stine of Chicago was introduced. He read a paper on "Safety Devices for Electrical Circuits," which was received with much interest and a vote of thanks was tendered Prof. Stine.

The question of selecting a place for the summer meeting was discussed, but no decision was reached at this session. In the afternoon the first order of business was the question of securing representation at Madison to watch legislation upon matters affecting the members. It was decided to appoint a committee for this purpose and empower it to take the necessary steps to guard the interests of the association.

The president announced the following committees:

Protective committee—Mr. Norcrosse of Janesville, Mr. Copeland of La Crosse, Mr. Mullen of Milwaukee.

Programme committee—Mr. Mercein of Milwaukee, Mr. Deland of Chicago, Mr. Korst of Racine.

Special committee—Mr. Collins of Elkhart, Mr. Coleman of Fond du Lac, Mr. Page of Oshkosh.

Insurance committee—Mr. Lord of Waupaca, Mr. Debell of Sheboygan, Mr. Merrill of Ashland.

Entertainment committee—Mr. Copeland of La Crosse, Mr. Hanley of Marinette, Mr. Daniell of Menominee.

Ways and Means committee—Mr. Pamperin of Oconto, Mr. Grimm of Jefferson, Mr. Davis of Neenah.

Final action was taken upon the question of selecting a place for the next meeting, La Crosse proving the choice of a majority of the members.

The secretary announced that he had received a letter from N. W. Perry of New York, regretting his inability to be present, and asking him to read the paper on the subject of "Gaseous Fuel as a Means of Cheapening Electricity."

Mr. Low's paper on "Electrical Supplies" was a very practical address and was listened to with close attention.

"Electric Heating," which was the subject of Mr. Cutter's paper, proved a very attractive topic, and the manner in which it was treated added greatly to the interest in the subject.

Mr. Doherty of Madison suggested the establishment of what might become the "question box," from which questions might be taken to be discussed at the meetings, giving every central station man an opportunity to ask questions which may be discussed and answered by those in a position to do so. "I have seen the plan carried out in two organizations that I belong to," he said, "and it has been very successful. It has led to increased membership, interest and general advantage."

Mr. Cutter of Chicago asked whether it would not be well to have the questions sent to the secretary, between the times of the meetings, in order that he might refer them to suitable members for reply, so that the answers might not be made entirely offhand.

Mr. Doherty replied that he belonged to a club known as the Engineers' club of Columbus, Ohio, which has stated meetings, where this plan is pursued with great interest. "We do not find that it consumes valuable time," he said; "the questions are mailed to every member on a postal card prior to the meeting, so that every person has an opportunity to look them up."

Before adjournment Mr Doherty said: "We have one associate member on our committee who last year obtained 11 new members for the association. I refer to Mr. Christie. Mr. Mercein has also mentioned the matter in his report, but I think it is no more than proper to acknowledge Mr. Christie's services in some way."

The secretary then moved that a vote of thanks be extended by the association to S. E. Christie of Chicago for his zeal in securing new members for the association. The motion was adopted unanimously.

Protective Devices for Transformers.[1]

By Herbert C. Wirt.

The transformer itself is a protective device, as it was introduced to permit the operation of incandescent lamps from high-voltage circuits, with safety to human life. It has so well accomplished this purpose that there are in operation in the United States four million 16 candle power lamps which are supplied with energy by means of transformers.

A large number of transformers were introduced 10 years ago, at a time when experience with electrical machinery for operation on high-voltage circuits was limited, and therefore many transformers were not properly constructed, and the failure of insulation may be laid in part to faulty design.

The object of this paper is to call attention to several protective devices which have been designed to render the transformer absolutely safe, and to suggest some precautionary measures that should be used by managers of central stations.

The cases which have occurred where the primary current has passed to the secondary wiring are comparatively few, but still sufficiently numerous to warrant the taking of greater precaution to prevent the possibility of fatal accidents.

This subject is receiving careful attention on the part of the underwriters, and many central station managers are looking into the question. Very little information has been published on this subject. William H. Merrill, Jr., electrician of the National Board of Fire Underwriters, has issued very valuable and interesting reports relating to fires of electrical origin, and during the last three years 62 cases have been mentioned by him, where the primary current has passed to the secondary wiring, and which have been considered only as a fire hazard.

The following cases have been investigated, and may be of general interest:

Fire No. 867.—Converter burnout. About 60 converters connected by aerial wires burned out by lightning.

Investigation showed that these burnouts occurred in transformers not insulated with oil. The primary voltage was 2,750. The line was not protected by line arresters, but was protected by station arresters. The secondary wires were run in a damp building and were quite likely grounded, thus affording an easy path for the primary current to reach ground through secondary wiring, and across the insulation in the transformer.

Fire No. 1,000.—Converter burnout. Primary current on secondary circuit. Current grounded through soft rubber insulating joints on combination fixtures. Rubber burned out and escaping gas ignited. Discovery prompt; electricity and gas turned off, preventing serious damage.

Fire No. 1,001.—Similar to 1,000. Small loss.

These burnouts occurred in transformers not insulated with oil, and which were connected to a 1,000 volt circuit. Lightning arresters were installed at station and on lines. These burnouts did not occur during a storm.

Fire No. 1,370.—Converter burnout. Primary current on secondary circuit. High-tension current grounded through secondary wiring to a gas pipe placed near a single-pole switch. Gas pipe was scarred by the arc; the switch and connecting wires were fused and the interior decorations at the point were damaged. Loss about $300.

Transformer was connected to a 2,000 volt circuit, was run without oil, and was not protected by line or station lightning arresters. The burnout occurred during a lightning storm. There was no evidence of a leak between primary and secondary previous to the storm. The transformer was of modern type and was first used May 27, 1895

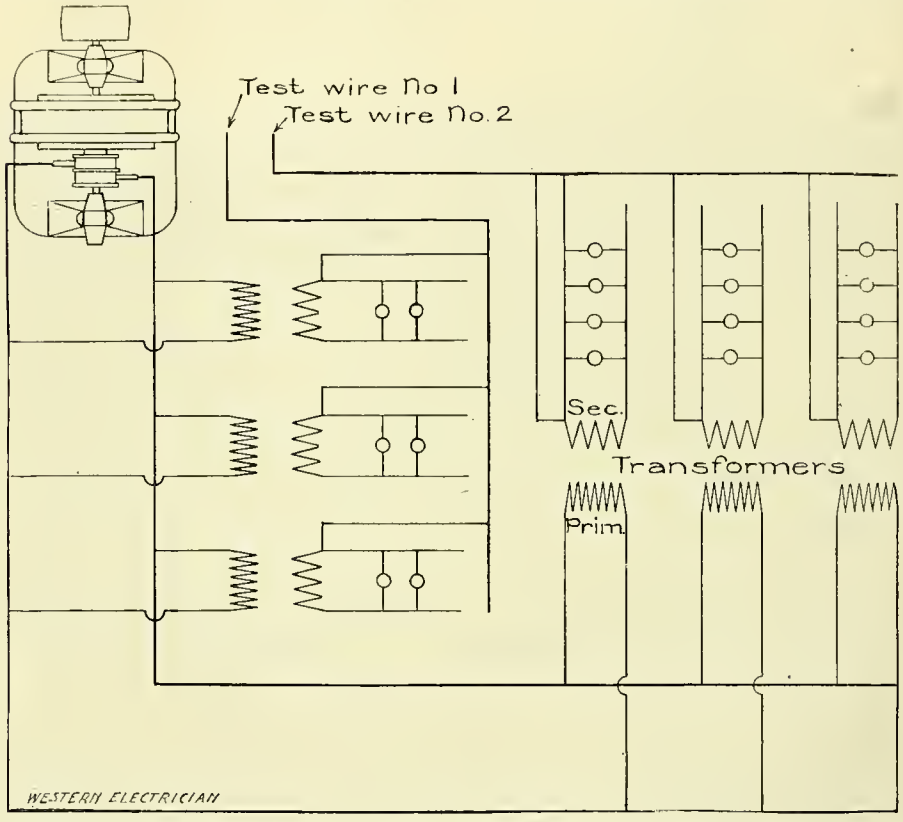
Fire No. 1,445.—Converter burnout. Primary current on secondary circuit. Current grounded through rubber insulating joints of fixtures burning out rubber, allowing gas to escape and igniting the gas. Part of the side wall and ceiling of the dwelling burned, together with partial destruction of carpet and some fixtures. Prompt discovery of the fire by a patrolman passing the building prevented serious loss, as the occupants were away at the time. Loss $150.

This burnout occurred during a lightning storm. Arresters were installed at station and on lines. In this transformer, which was manufactured in 1888, oil was not used Primary voltage 1,000.

Fire No. 1,446.—Converter burnout. Similar to No. 1,445. Part of ceiling and joists of dwelling house burned. The occupants managed to shut off the gas at the meter immediately the fire was discovered. The case of this transformer had originally been grounded, but the ground wire had been cut subsequently. Loss $50.

Transformer was connected to 1,000 volt primary; was protected with arresters, and no oil was used.

You will note in every case, the electrical discharge ignited the gas. It is easy to see the cause of this. The current passes from the secondary wires to the fixture, and then across the insulation in joint to the gas pipe system and to earth, forming an arc at the insulated joint, thus setting fire to the gas. If, however, insulated joints were not used, the path to earth from the secondary wires would be made easier, and probably a greater number of breakdowns would occur.



PROTECTIVE DEVICES FOR TRANSFORMERS.—CONNECTIONS OF TRANSFORMER TEST WIRES FROM CENTRAL STATION.

Note that all these accidents occurred in transformers that were not insulated with oil. Note also that many of these breakdowns occurred during a lightning storm, proving conclusively that most transformers are burned out, not by the alternator current, but by electrical discharges, due to disturbances of the atmosphere. It is, therefore, necessary to have a transformer insulated to stand such discharges, rather than to stand the alternator potential.

In the early days of transformer construction, the insulation was not designed to stand any definite voltage in excess of the alternator voltage. A transformer was supposed to be properly made if it did not burn out when tested on the standard current for which it was designed. Transformers of early design will just stand a high potential test of 3,000 volts.

The majority of transformers manufactured during the past year are made to stand a test of 5,000 volts between primary and secondary windings. One manufacturer has brought up the standard of insulation on his transformers sufficiently to stand a 10,000 volt alternating current test between primary and secondary.

The insulation of transformers should always be measured by high-potential current rather than by an insulation resistance test, in which a moderate voltage is used Even 500 volts is not sufficient to properly test transformers, for it is easily seen that a small gap or break in insulation may be great enough not to be bridged by a 500 volt current, but the normal alternator potential of 1,000 to 2,000 volts will immediately start an arc across the defective insulation.

Oil should always be used to insulate transformer

1. Read before the Northwestern Electrical association, Milwaukee, January 20, 1897.

windings, as a high-potential current will jump a space in air five times as great as in oil. The oil keeps the air from the coils and prevents oxidation of the insulation material. The air in a transformer not insulated with oil is heated and expanded from the coils, and when the transformer is cooled air containing moisture can be drawn into the coils.

A number of automatic devices have been designed to be connected to the secondary wiring of transformers, so that in event of the high-tension primary current passing to the secondary wiring, it will be automatically connected to the earth, thus preventing any danger of a shock, or the possibility of causing a fire.

The most prominent devices are those designed by Prof. Elihu Thomson in this country and by Major Cardew, electrical adviser of the Board of Trade in England.

The Cardew earthing device, illustrated herewith, consists of two metal plates, separated and insulated from each other by one-fourth inch air space. The plates are held in a horizontal position. A thin strip of aluminum foil, about three inches long and one-fourth inch wide, is flexibly attached at one end to the upper plate, which is connected to the secondary wiring, and the other end is supported near to, but normally not in contact with, the lower plate, which is connected to a good ground. If a difference of potential of about 300 volts exists between these two plates the aluminum foil is attracted to the lower plate and will remain in contact with it until the primary fuses are blown. This, therefore, automatically grounds the secondary whenever there is a difference of more than 300 volts potential between secondary wires and earth.

Several thousand of these devices are in use in England, as such apparatus is required by the following regulation of the English Board of Trade:

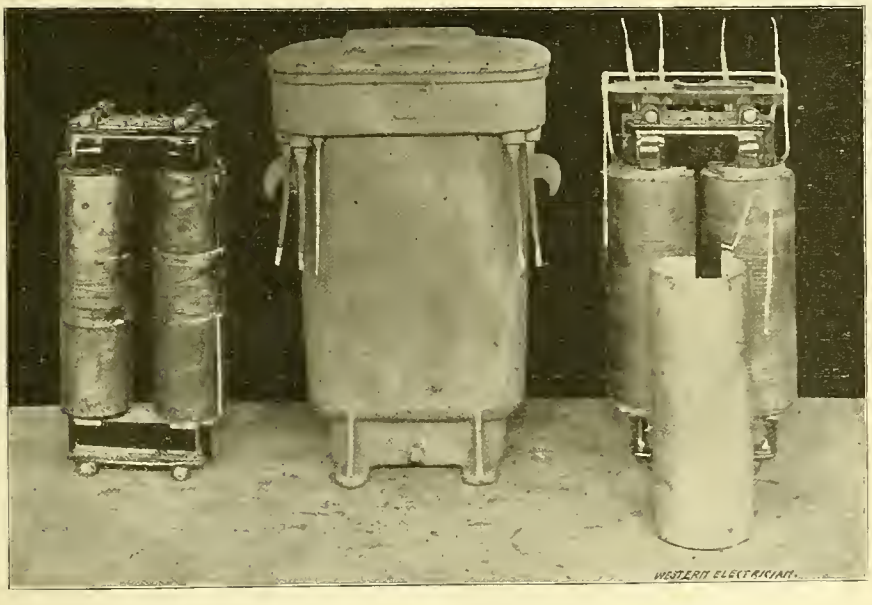
> In every case where a high-pressure supply is transformed for the purpose of supply to one or more consumers, some suitable automatic and quick-acting means shall be provided to protect the consumer's wires from any accidental contact with or leakage from the high-pressure system, either within or without the transforming apparatus.

On the three-wire system the device is connected to the neutral wire. With small transformers it is connected to only one side of the secondary circuit, and with large transformers one is placed on each secondary of wire.

It should be mentioned that most of the primary wires are run underground in England, and the transformers are not, therefore, subjected to atmospheric discharges of electricity.

Prof. Elihu Thomson has invented several protective devices. The film cut-out, so called, is quite similar in its action to the Cardew earthing device, the only difference between the two being that the plates are separated by a thin film of paper, which is pierced by a potential of 300 volts, making a good connection, and thus permitting the primary fuse to melt. The device was first commercially used in 1890. The transformers at that date were so poorly insulated that it was found that the primary current passed to the secondary wiring so frequently that their use had to be abandoned.

Prof Thomson's most prominent protective devices, developed in 1885, are known as the ground shield and grounded secondary. The ground shield consists of a sheet metal covering, placed in the transformer between the primary and secondary windings, in such a way that it is impossible for any current to pass from the primary to the secondary windings without connecting with the metal shield. The shield is connected to a good ground, and therefore the primary current will not pass to the secondary wiring.



PROTECTIVE DEVICES FOR TRANSFORMERS.—GROUND SHIELD OF TRANSFORMERS.

The most notable installation in this country of transformers with ground shield, is at Elizabeth, N. J. The transformers were constructed to stand a 10,000 volt high potential test from primary to secondary, and 5,000 volts from primary to ground shield.

There are 225 transformers installed, and they have been in operation about three years, and the total number damaged by lightning has been seven. The electrical engineer in charge reports that he has no records to show how many transformers were burned out by lightning previous to the time the ground shield transformers were installed, and he can therefore make no direct comparison. The lines extend some 250 miles overhead, running as far as 9 miles from the station, and he thinks the district is very subject to lightning disturbances.

The lines are protected by 60 line arresters and an equipment of station arresters of an approved type. The engineer reports that whereas the ground shield seems to create more of a tendency for the lightning current to burn out the transformer, it has prevented the primary current connecting with the house circuit and thereby endangering life.

We wish to state that the lightning arresters which are protecting these lines are of a type which require

PROTECTIVE DEVICES FOR TRANSFORMERS.—CARDEW EARTHING DEVICE.

approximately 8,000 volts to bridge the gaps separating the line from the ground wire, and whereas the transformers are only insulated from ground shield to primary wires to stand 5,000 volts, it is evident that there is a possibility of the lightning current passing to ground through the transformers instead of through the lightning arresters.

Transformers fitted with ground shields are quite generally used in England, as these transformers meet the specifications of the Board of Trade.

In the grounded secondary system the house wiring is permanently connected to ground. This connection may be made from either side of the secondary, or carried from the middle point of the secondary winding in the transformer. In the latter case there is a difference of half the potential of the secondary system existing between the secondary wires and the earth. If only one of the secondary wires is grounded, there exists a difference of potential between the earth and the other secondary wire equal to the full secondary voltage.

These systems, therefore, are objectionable from an insurance standpoint, as it has not been thought desirable to have the secondary system grounded, on account of the danger of leakage of the secondary current.

The film cut-out and Cardew earthing device have an advantage over permanently grounding the secondary, as there is less liability of a leak from wires to ground, except at the time when the devices are short-circuited.

A large installation in the town of Suncook, N. H., has been in operation during the past year, with a grounded secondary. The installation consists of 2,000 lights, located in several mills, and about 500 in the town. The generating station is located six miles from the town and mills; primary, 2,500 volts. A three-wire secondary system is used—100 volts on each side. The neutral wire is grounded. The lines are well protected by lightning arresters, which were not of the short-gap type.

Two transformers have burned out, but after a careful examination the conclusion was arrived at that one of the transformers at least had been injured by water, as the transformer box had been opened during a heavy rainstorm. If the short-gap lightning arresters were used, there would be less liability of the transformers burning out.

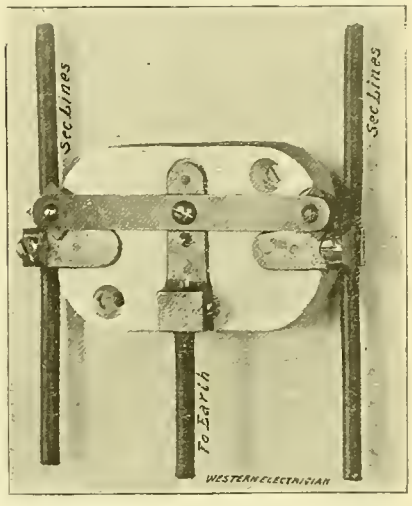
It will be seen from the above that the lighting arrester is a very important protective device, as we must depend upon arresters to conduct the lightning discharges to the ground. If we did not use arresters, it would be almost impossible to construct a transformer that would not burn out. We might use a protective device, to prevent any danger from the current passing to the secondary wiring, but we would frequently have transformers burn out.

Arresters have heretofore been designed solely for the purpose of preventing the dynamo current maintaining an arc after the passage of the lightning discharge. A new arrester has been designed, which affords an easy path to ground for the lightning current.

A careful test of the various arresters on the market to-day shows that the 1,000 volt arresters require from 3,000 to 4,500 volts and the 2,000 volt arresters require 6,000 to 9,000 volts potential to cause the current to pass from line to ground across the gaps.

As the insulation of the transformers can best be tested by a high-potential current, so also arresters should be tested by the same high-potential current, and they should be constructed so the current will pass across the gaps in preference to passing through the insulation of the transformer.

The necessity of a short-gap arrester has undoubtedly been known to many experimenters, but until recently no method was devised to permit the short gap arresters to be used on high-voltage alternating currents. We are pleased to say that an arrester has recently been designed so that but one gap of $\frac{1}{32}$ inch is required for a 1,000 volt arrester and two gaps of $\frac{1}{32}$ inch each for a 2,000 volt arrester, requiring 2,000 and 4,000 volts respectively for the current to pass across the gaps.



PROTECTIVE DEVICES FOR TRANSFORMERS.—THOMSON'S ARRANGEMENT.

It is believed that these arresters will afford protection to transformers provided with insulation that will stand a 5,000 volt potential test.

This arrester consists of large metal cylinders, separated by short air-gaps in series with which is placed a low non-inductive resistance to limit the current at short-circuit. The arc is cooled so that upon the reversal of the alternating machine current, it is extinguished.

Transformers having defective insulation between primary and secondary should be immediately disconnected. The only way to discover a transformer of this kind is to make insulation tests, and therefore it is apparent that periodical tests should be made of the insulation between primary and scondary of all transformers.

As a high-potential current is necessary, a small step-up transformer should be used, which can be carried around to the points where the transformers are located. This transformer should have a capacity of at least two kilowatts for testing transformers of 30 kilowatts capacity and less, in order to supply the capacity current.

In making a test, the house transformer is disconnected from both the primary and secondary wires. The primary of the test transformer is connected to primary lines, which are energized by the alternator. The secondary is connected to the house transformer; one side to primary, and the other to secondary. A rheostat, or reactive coil, is located in series with the primary of the test transformer, so the secondary voltage may be varied between the limits of 2,500 to 10,000 volts. A fuse should be located in the primary circuit, to open when the insulation is punctured.

The high-potential current should be applied for 60 seconds, and any transformer that will not stand a 3,000 volt test should be scrapped. It will be found that the transformers that have poor insulation also have very high core losses and are not economical, for in many cases it will be found that the revenue obtained from the

[*Continued on page 64.*]

H. C. Higgins, President Northwestern Electrical Association.

In selecting H. C. Higgins as president of the Northwestern Electrical association, that organization conferred well-deserved honor upon a pioneer in the lighting business in the Northwest, and at the same time showed its appreciation of the valuable service of one of its ablest and most energetic members. Those who attended the midsummer gathering of 1896 will readily understand why there was such unanimity in the support accorded Mr. Higgins when his name was mentioned for the presidency.

Mr. Higgins is at present the president and manager of the Gas, Electric Light & Street Railway company of Marinette, Wis. He engaged in the lighting business in 1877, when he built the gas works at Dixon, Ill., to which was afterward added an electric light plant. This was only the beginning. He constructed several gas and electric light works in the Northwest, notably at Neenah and Menasha, Stevens Point, Ashland, Ripon and Marinette, all in Wisconsin, and in Escanaba, Ishpeming, Big Rapids, Mich., and other places. In all

H. C. HIGGINS, PRESIDENT NORTHWESTERN ELECTRICAL ASSOCIATION.

of these enterprises Mr. Higgins has been the largest stockholder, and in some of them he owns the entire business. He holds the controlling interest and is president and manager of the Marinette Gas, Electric Light & Street Railway company, the works of which were built by him.

Mr. Higgins is identified with nearly every public improvement or enterprise that has been started in the thriving city of Marinette since he became identified with the place in 1888. He helped to organize and is one of the directors in the First National Bank there; he was also an organizer and is a director in the Hotel Marinette. He was the leading spirit in organizing the Oakwood Beach club of Marinette, of which many of the members of the Northwestern Electrical association have most kind remembrances, having been entertained at the Casino, on the club's beautiful grounds, on Green Bay, at one of its charming parties during the convention of the association in Marinette in July, 1896.

Besides these interests Mr. Higgins has large investments in real estate within the city of Marinette and elsewhere. Mr. Higgins was one of the very first owners of gas interests who realized that electricity had come to stay, as an illuminant, and advocated adding it at once to the gas business. He is now giving about all his attention to his Marinette interests.

Mr. Higgins was married in 1890 to Miss Helen Gaffney of Neenah, Wis., the youngest daughter of Philip Gaffney, a prominent dry goods merchant of that place. They have two children, the first, Henry C., Jr., five years old, and the second, Kathryn Helene, is six months old.

Electricity in the Government Printing Office.

An isolated plant having 127 electric motors and 5,000 incandescent lamps is certainly of more than ordinary interest. Such an installation is that in the Government Printing Office at Washington, and in their reports to the public printer George E. Reid, the chief engineer, and W. H. Tapley, the chief electrician, give many valuable details of the operation and economy of the plant. Mr. Reid's report is dated December 8, 1896, and an abstract follows:

The boiler plant in use consists of two double-return horizontal tubular boilers, externally fired, and one locomotive boiler, internally fired, the latter having attached a vertical economizer, through which the feed water for all the boilers is forced. The total heating surface is 5,600 square feet. The total grate surface is 154 square feet, making the ratio of grate to heating surface as 1 to 36.4. During the year the furnaces of the horizontal boilers were renewed, and the economizer was fitted with a new set of tubes.

The power plant consist of one condensing single-cylinder beam engine, rated at 80 horse power, driving the portion of the main press room still driven by shafting and belts; one condensing vertical compound engine, rated at 250 horse power, driving the three belted generators in dynamo room; one Westinghouse compound condensing engine, also rated at 250 horse power, driving a direct-connected generator. During the last session of Congress either one or the other of the compound engines in the dynamo room was in continuous service 24 hours per day from 8 A. M. of Monday morning until 7:30 or 8:30 A. M. of the following Sunday morning, while the beam engine in the press room was run eight hours each day, Sundays excepted. After the adjournment of Congress in June, the running time of the electric plant was cut down from 24 to 16 hours per day, while the running time of the press-room engine remained the same as before.

Previous to the installation of the new electric generating plant in 1895, the maximum work done was 370 horse power. After the completion of the installation of the new generating plant in the dynamo room, the substitution of motors for engines in the stereotype foundry, machine and carpenter shops, the adding of a steam pump to supply the new closet system with water, and the introduction of pumps to return the water of condensation to the boilers, the work done was 555 maximum horse power, showing an increase in steam consumption for power alone during the year of 185 horse power.

Although during the past year the demand for power has been at times 185 horse power in excess of any previous year, with an additional demand for heating of nearly 400,000 cubic feet of space, yet the coal consumption to meet these new requirements was but 203.1 tons more than for the year ending June 30, 1894, which period also embraced a long session of Congress.

Experience with the two types of boilers in use at this office, viz., externally and internally fired, has demonstrated that the internally fired boiler, with its economizer, is the more economical. The plans and specifications for the two 300 horse power steel boilers authorized by Congress at the last session called for the construction and erection of two internally fired Scotch boilers, each with its attached fuel economizer. These new boilers have been constructed by the I. P. Morris company (Cramp's), of Philadelphia, and will be under steam January 1st. They are 12 feet in diameter by 14 feet one inch long, and the economizers seven feet in diameter by 10 feet six inches high, the combined heating surface in both boilers and economizers amounting to 7,476 square feet. The grate surface in both boilers is 105 square feet, making the ratio of grate surface to heating surface as 1 to 70.9. On the same basis of computation as applied to the old boilers, the new ones will yield 560.7 horse power, which, added to the rating of the old, gives the steam plant a total capacity of 930.7 horse power.

The new boilers are designed to carry a pressure of 150 pounds per square inch, which will enable the compound engines to develop their maximum power and efficiency. Their type and construction promise that they will be the most efficient boilers in use in this city. I recommend that two additional boilers of the same type be purchased at once, to occupy the foundations already prepared for them in the new boiler house.

The new boiler house is located on the south side of Jackson alley, west and south of the office building. It is a one-story fireproof structure, square in plan, and has a frontage on the alley of 56 feet. The smokestack, or chimney, is a self-supporting structure of steel plate, lined with brick. The top of it is 150 feet above the cast-iron base, and 156 feet above the pavement of Jackson alley. The flue of the brick lining is of six feet four inches uniform diameter to the top. The house is designed to accommodate four 300 horse power boilers, to be placed in pairs.

The tunnel or conduit through which the steam mains are led to the engines is four feet wide by four feet high in the clear and constructed of brick, with concrete floor. The top is a semicircular arch. The sides and top are 13 inches thick. There are three lines of pipe through the conduit, a 10-inch or high-pressure line, a six-inch low-pressure line, conveying steam for heating to the new building, a four-inch water main for conveying the returns, or water of condensation, from all the heating systems to the feed-water receiving tank in the new boiler house. All of these mains are made of heavy wrought-iron pipe, and are carried in cast-iron brackets built in the walls of the conduit.

Mr. Tapley's report is more purely electrical and is given in greater detail:

Supplementary to my report of one year ago, I have the honor to submit the following concerning the progress of the electric plant, which was then just being installed.

We are now lighting the entire Government Printing

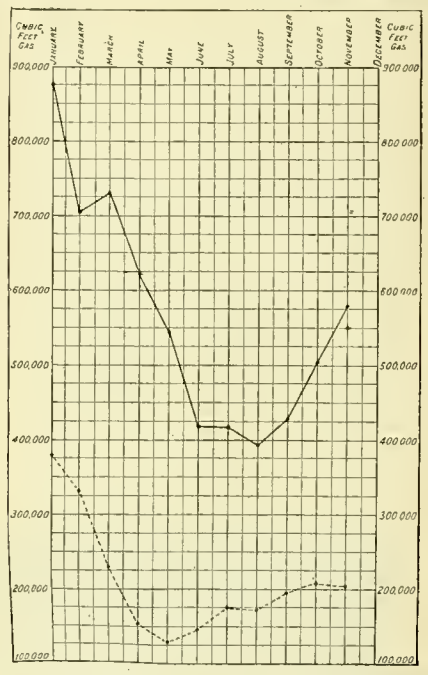


FIG. 1. ELECTRICITY IN THE GOVERNMENT PRINTING OFFICE.—RECORD OF GAS CONSUMED (SOLID LINE) IN 1895 AND IN 1896 (DOTTED LINE).

Office by electricity, while at that time only a portion of the first and second floors and the foundry were thus supplied. The installation of electric motors has progressed very rapidly, and at present all the machinery in the office, except about 20 printing presses, is being driven by electricity.

When the balance of the presses are thus connected, the entire office will be controlled from the dynamo room instead of having to depend on the various engines located at different parts of the building, as formerly. Everything is concentrated in one room, apart from the balance of the office, where the very best of care can be given to the machinery at all times, which could not be done when it was situated among presses, etc.

The matters of lighting and power are so different, each deserving of special mention, that I have decided to treat them separately.

LIGHTING.

There are at present connected to the electric lighting mains over 4,200 16 candle power incandescent lamps. This number will be increased to about 5,000 when all the additions are completed which are now under way. On September 1, 1895, we had some 1,400 16 candle power incandescent lamps in the office, distributed between the first and second floors and the foundry. Since then every part of the building has been supplied with electric lights, gas for lighting only being used for the pilot lights during the hours when the electric plant is not in operation.

From January 1st to November 30th of this year (1896) there was used in the Government Printing Office 3,877,300 cubic feet of gas less than during the corresponding months for the year 1895.

After the adjournment of Congress, in June, 1896, the

electric plant was in operation from 8 A. M. to 12 midnight on each week day, the run from 4:30 P. M. to 12 midnight being made for the sweepers. Consequently we were using gas Sundays and eight hours each week day (midnight to 8 A. M.) to sufficiently light the building for the watchmen to make their rounds. During these 11 months there was used 1,520,700 cubic feet of gas for this alone, and 808,600 cubic feet in finishing room of bindery and foundry for manufacturing purposes. This large amount of gas could be reduced to that used for manufacturing purposes by either running the plant continuously or the introduction of a storage battery which would take care of the lighting load Sundays and from midnight to 8 A. M. on week days. The latter method would be much the more desirable and economical. We would thus be entirely independent of any or all outside sources for the lighting of this building.

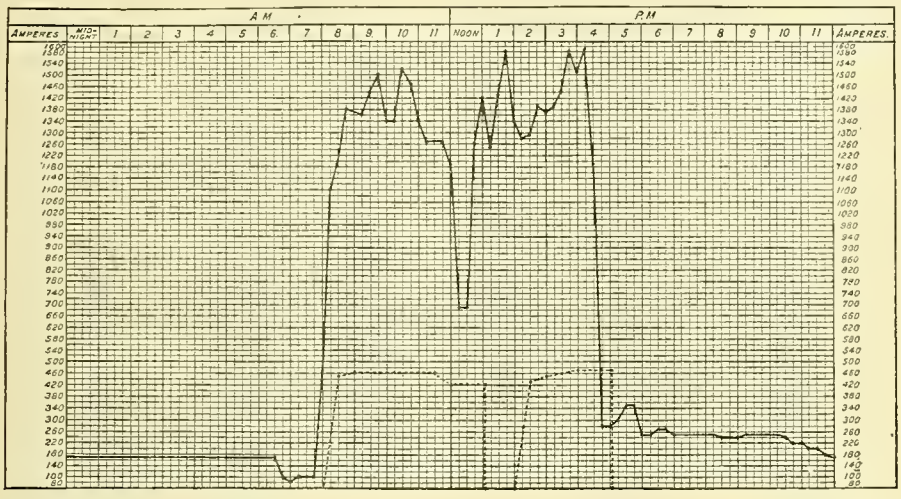


FIG. 2. ELECTRICITY IN THE GOVERNMENT PRINTING OFFICE.—DIAGRAM OF OUTPUT OF ELECTRIC PLANT FOR (DOTTED LINE) NOVEMBER 12, 1894, AND (SOLID LINE) NOVEMBER 12, 1896.

Accompanying this report is a diagram (Fig. 1) showing clearly the saving of gas during the year 1896 over that of the previous year, 1895.

The month of May was the lowest point reached. From that time on there was a gradual increase, owing to the fact that the electric plant was in service only 16 hours daily after the middle of June.

Diagram No. 2 (Fig. 2) shows the growth of the electric plant of this office during the past two years. The upper or solid line shows the electrical output in amperes on November 12, 1896. This was a cloudy day, thus accounting for the heavy lighting load during the daytime. The lower or dotted line shows the output in amperes of the old electric plant on November 12, 1894. This is for lighting only, as at that time we were running no motors for power work in the office, while the card for November 12, 1896, was nearly one-half motor load.

These are mean readings and not the highest fluctuations of the load, which frequently during the day reached to over 1,800 amperes.

This card more completely shows the rapid increase in our electrical output than could a lengthy description of what we are called upon to do in our central station.

Not only has the plant been enlarged, but at the same time it has been greatly increased in efficiency over the old plant, both in generators and engines. The lamps and wiring also largely aid in giving a greater percentage of light without an increase in power or consumption.

To show this completely, I have plotted a diagram (Fig. 3) of the average readings for the first week in November during the years 1893, 1894 and 1896. During the year 1895 we were putting in our new electric plant, consequently no readings were taken. These readings are for lighting only, as we only started to use electric motors for power during the present year. Line *A* is for November 2–7, 1896; line *B* for November 5–10, 1894; line *C* for November 6–11, 1893.

The most remarkable thing in this diagram is the fact that the lighting load during 1893 was the largest during the daytime, and that of 1896 the lowest. When it is considered that in 1893 we only had wired some 1,200 16 candle power lamps and in 1894 about 1,400, in November, 1896, there were over 4,000 16 candle power lamps connected to our lighting mains, completely supplying the building with light in all parts then in use, the result is worthy of special note. It may be accounted for by the high efficiency of our lamps and the high standard of all the apparatus connected with the lighting system, from the dynamos to lamp sockets.

It so happened that there were two cloudy days in each month of the three years, thus putting each week on a practically equal footing. During a week in which the majority of the days are cloudy our lighting load at the present time would average much higher than is shown by this diagram, but on clear days, as is clearly shown, there is not much wasted light in comparison to former years.

ELECTRIC MOTORS.

The application of electric motors to the machinery, owing to its great variety, presented many problems, as well as complicated conditions, which had to be met and solved. How well they have been solved is shown by the large number of individual motors now running successfully.

We are operating printing presses of all sizes and types, from large web presses, printing at the rate of 11,000 per hour, down to an eighth medium Gordon press; also cutting, indexing, stabbing, folding and case-making machines, signature presses, blowers, ruling and sewing machines. These latter are operated by a one-sixth horse power motor connected direct to worm gear reducing motion. A reduction in some cases is required of from 1,800 revolutions per minute down to 35.

All the plans and designs for this entire work were laid out and executed by the engineers and workmen of this office, no outside assistance whatever being called into consultation; nor was the work of the office interrupted while all these changes were being made.

There are now in daily use 117 direct-connected and 10 belted motors, varying in size from one-sixth to 30 horse power, making a total of 383 horse power in electric motors. Added to this is a 30 horse power motor, used in connection with the Sprague elevator in the new west wing, making a total of 413 horse power of electric motors thus far installed in the office.

Three small engines in foundry, carpenter, and machine shops have been stopped and their work is now being done by belted motors.

During the past year there have been no shut downs or any delay in work during the installation of the various motors, nor have we experienced anything but the best results since they have been in daily operation.

During the last session of Congress a 15 horse power motor was attached to a line of shafting which drove 13 drum cylinder presses. On these presses was printed all the congressional work. Heretofore it has been the custom to run the presses from the old press-room engines, consequently turning all the line shafting in the building, even if only three or four presses were running. The foundry being driven by a separate engine, it necessitated an engineer on duty there as well as in the press room. Under the system of electrical transmission of power this was driven from one central station. The men who attend the engines and dynamos supplying light to the building also attend to the power transmission. The saving in wages for this session of Congress alone amounted to more than enough to pay for the motors installed in foundry (one 30 horse power), folding room (one 15 horse power) and press room (one 15 horse power).

The entire power necessary to do all the work of the office at night, including the running of the large web presses on which the *Record* is printed, did not amount to within 15 to 20 per cent. of the friction load of the press-room engine and shafting. This one item alone shows how great have been the gains of electrical transmission of power over the old belt system.

The subdivision of power sources has reduced the possibility of shut-downs to the very smallest degree and these could only affect a very limited portion of the office. With the introduction of so many motors in so short a period into the building, the turning over of same into the hands of persons, many of whom were women, wholly without any experience in the handling of such apparatus, made it absolutely necessary that there be adopted some method of control and protection against carelessness and ignorance. The old method of fuses as a protection to motors, generators, or the building itself, was discarded as totally unreliable and dangerous. A positive and at the same time simple device to accomplish this result was desired—something which was governed absolutely by positive forces, not by springs. Such an instrument, in shape of an automatic circuit-breaker, was found—an automatic circuit breaker, operated solely by the forces of magnetism and gravity. A long and severe trial proved that it fulfilled all of our exacting conditions. This may be readily shown in the matter of maintenance of the motors. During the entire year we have not had an armature burn out (save one belonging to a motor put in on trial) or a field coil give out on one of the motors from one-fourth up to 30 horse power. Had we not been amply provided with positive-acting devices which would not allow the improper handling of motors or machinery to which they were attached, our record of repairs for the past year would not have been so slight or the service given so satisfactory.

The connecting of motors direct to the printing presses has more than fulfilled the results anticipated therefrom. Not only has the production been increased somewhat over 15 per cent., but the character of work on many of the older presses has been greatly improved, slurring and poor register entirely disappearing. This is largely accounted for by the constant speed of the motor, while with belting there was always more or less slipping.

GENERAL SUMMARY.

Should we be called upon to furnish at any one time sufficient power to supply all the lights and motors now installed in this building it would require a plant of at least 1,000 indicated horse power when forced to its utmost. Even then we should not be able to supply the maximum wants of the office.

Cloudy days, even when the motor load is light, we are required to run both of our engines to meet the demands for light and power. When both engines are running, we are without any reserve whatever in case of accident to either generators or engines. Should anything happen, it would necessitate a partial shut-down of either lights or power until such damage could be repaired.

I would strongly recommend that the power plant be supplemented by the addition of a large direct-connected unit of at least 300 kilowatts capacity, or the installation of a storage battery sufficient in size to supply the office with light during the hours the electric plant is not running. The latter plan will, I believe, be the more economical and satisfactory, as it will enable us to always run the plant at its highest efficiency. The storage battery could be so arranged as to run in multiple with the generators now in use whenever extra heavy demands required it, or take the place of one of the engines for a limited time should one be under repairs; or in case of a total breakdown to the steam plant the battery could be made large enough to take care of the entire output of the office for several hours, thus making us practically independent of the generators.

During the months from January to November, both inclusive, there was burned over 1,500,000 cubic feet of gas aside from that used for manufacturing purposes. This lighting could be entirely supplied by the storage batteries at a very much less cost than is now paid for gas. All current supplied to storage batteries would be

[*Continued on page 68.*]

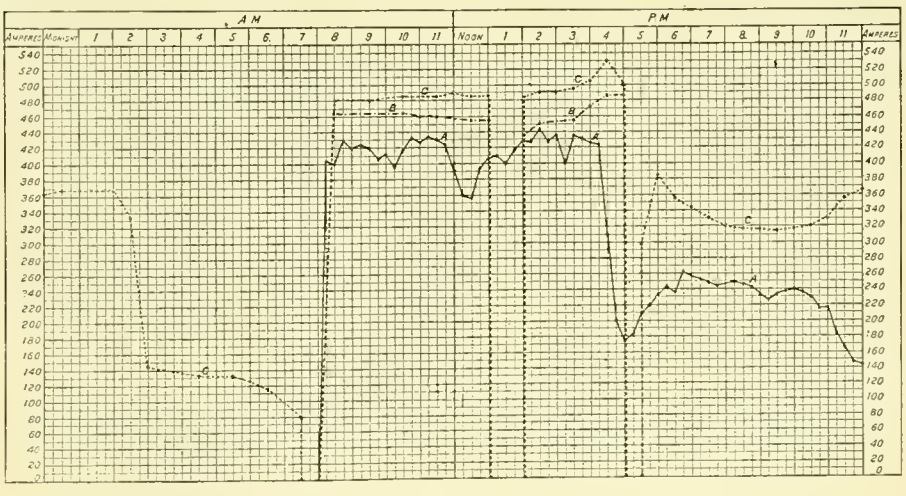


FIG. 3. ELECTRICITY IN THE GOVERNMENT PRINTING OFFICE.—DIAGRAM OF AVERAGE RECORD OF LIGHTING OUTPUT (A, NOVEMBER 2-7, 1896; B, NOVEMBER, 5-10, 1894; C, NOVEMBER 6-11, 1893).

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AN Englishman has secured an American patent upon an "electrically illuminated jugglery apparatus," the principle of which, as explained in the application, is the same as that embodied in a design of this kind used in this country for several years. None of those who have used the apparatus mentioned have considered it patentable, probably because the scheme was so old and so well known that it was regarded as public property.

INDEPENDENT telephone companies in every part of the country are displaying great activity at this time, and, generally speaking, they are well pleased with present conditions and the prospect for the coming year. There seems to be a good feeling among the anti-Bell companies, and in many localities there is evidently a working agreement to co-operate against the common enemy. But it must be admitted that the contest is not entirely one-sided. The Bell interests seem to survive and prosper in spite of the hard knocks which the outside companies are constantly administering. Reports from local Bell companies show that they are gradually spreading out, and none of them seem to be actually losing money. But some of them show the effect of competition. The Central Union company, for instance, complains that it is required to make prices at times which do not give any profit, yet the independent companies contend that they can give first-class service at these reduced rates and show a fair return. If the representations of the Central Union company are accepted, the conclusion that inevitably follows is that its arrangement with the American Bell Telephone company is not advantageous. Where there is active competition local Bell companies seem to be greatly hampered, probably because of the exorbitant charges of the parent company. Complaint is made that the protection for which the local companies pay is not accorded them, and that they are therefore very seriously handicapped. In Chicago, however, the conditions are very different. The Chicago Telephone company keeps up its prices despite public clamor, and while complaint is general against existing conditions the people submit because there is no redress. Thus far the company has been fortunate in having no serious competition, and there seems to be no immediate prospect of relief in this quarter. The company continues perfecting its organization, extending its system, and thus providing the best possible protection against competition in the future. At the same time it does not neglect to keep its stockholders in good humor, as will be readily understood after a perusal of the report published on another page this week.

MILWAUKEE was the scene of the latest gathering of electrical men, the convention of the Northwestern Electrical association, last week, which was attended by central station men, street railway officials, manufacturers and dealers in electrical apparatus, contractors, insurance men and engineers of prominence. All of these interests were represented in the discussion of papers presented at the several meetings, and as some of them were upon subjects of vital importance to the members who were not, by the way, all of one mind, it may be taken for granted that the meetings were interesting and the discussions animated.

The subject that occupied the most attention was "Municipal Ownership." Many of the central stations represented in the association are located in towns where this pernicious theory has gained some ground, and it was but natural that members from these places would express their views very freely upon the subject. Steps were taken to head off adverse legislation, which has been threatened at Madison this winter. Three members were appointed a committee to represent the association and oppose any bills directed against the interests of the members. Other measures in the line of defense were also adopted. It is rather a singular fact that the representative of the manufacturing company that has secured most of the contracts for municipal plants in this part of the country vigorously opposed the policy of municipal ownership and stated that he represented the views of the management of his company when he said that city plants were bound to be failures because of the poor management which, in the nature of things, followed the system of appointment through political influence that prevailed in all municipal undertakings. It would certainly be interesting to learn how this opinion would impress those who have purchased equipments from the company mentioned for municipal stations, as was suggested at the meeting, but it would be of more practical benefit to the organization to have copies of this address printed by the association and supplied to members wherever there may be agitation of this question.

Considerable surprise was manifested when it was learned that the National Electric Light association had practically refused to co-operate with the Northwestern association in securing material with which to fight municipal ownership. It would be unfortunate if there should be any misunderstanding between these organizations, as there should be no internal dissensions, no conflict of interests, at this important period. They should work together, and we believe it is the wish of the members of both associations that they co-operate, especially in this particular case. From the reports at hand, which, it must be admitted, are incomplete, it is hard to discern any real cause for a conflict. It may be that the National association desires to be recognized as the principal organization, but in a case of this kind petty quarrels over questions of precedence make those who engage in them simply ridiculous. The ostensible aim of the National Electric Light association is the advancement and protection of the interests of its members, not the glorification of its officers. In the Northwestern Electrical association it would have gained a valuable aid—a young and vigorous organization that has already accomplished much for the industry and gives promise of still greater achievements. We sincerely trust that it is not too late to effect a settlement of any differences that may exist between these organizations, and that at an early day announcement will be made that they are earnestly working together in the common cause.

THOSE who are familiar with the financial condition of this municipality will not be likely to consider seriously the proposition submitted to the City Council to have the corporation counsel prepare for presentation to the Legislature a bill amending the charter act so as to authorize cities to own, operate, license or control telephone systems, gas works, street railways and electric lighting plants. Just now the city finds it difficult to obtain sufficient funds to provide for the necessary expenses of the administration. Work that rightfully comes within the province of the municipality is either neglected altogether or only partially done. For instance, the streets, even in the down-town business district, are not properly cleaned, police protection is inadequate, the water supply is not equal to the demands of consumers, garbage and refuse is permitted to accumulate until the alleys are choked and the health of persons in the neighborhood endangered, public schools are overcrowded and many children are consigned for instruction to stores and rooms in buildings unsuited for the purpose. This condition prevails in every department of public service, and the excuse advanced for all these abuses is lack of funds. If this be true, how can the city undertake new obligations that will require the investment of vast sums of money that should really be expended for much-needed improvements in the present service? If the city can raise money it should do so at once; not, however, for the purpose of establishing municipal control of lighting, street railway and telephone service, but for the improvement of the service of the street department, the police department, the health department, increasing the water supply and providing fitting accommodations for children of tender years for whom no room can be found in the present public school buildings and who are consequently huddled together in poorly lighted, poorly heated and poorly ventilated rooms of business blocks that were never intended to be used for educational purposes. When the city shows that it is capable of doing this work properly it will be plenty of time to discuss the merits of the proposition to engage in furnishing light and telephone service and operating street railways. When that time comes there will be many features to be taken into consideration, including the rights of the corporations in law and equity, public policy and the effect of such hostile action upon vested rights. It must be remembered that the result of an attack upon public enterprises is always disastrous, and any community that establishes a reputation for disregarding the rights of property and failure to comply with the provisions of public franchises upon the strength of which large sums of money have been invested will find it difficult to interest capitalists in its public schemes or even in private enterprises. There is another feature of this question that seems to be entirely overlooked by the advocates of such measures. It does not seem to occur to them that if it prove so difficult to properly conduct city departments in which only common labor is required, such, for example, as the street department, the difficulties will greatly increase when the establishment, maintenance and operation of enterprises requiring technical experts and skilled labor are undertaken. Chicago's experience in this line should prove a warning to all well-meaning advocates of this policy.

There is one feature of the present movement that should not be overlooked or forgotten. The order introduced in the Chicago City Council does not provide that the city shall own and operate the telephone system, the street railways and the lighting plants, but gives it the right to do so whenever that policy may appear expedient, in whole or in part. This is a significant fact and may furnish an explanation of the action of the aldermen in pressing the matter at this time. Such an act as that proposed would give boodlers a convenient club to hold over corporations and would enable them to exact payment from these companies for being let alone—a system of blackmailing that would doubtless be effective, especially as corporations cannot afford to have public confidence shaken. Any corporation that would be liable to such interference would necessarily find it hard work to borrow money upon its securities. For this reason alone, the proposed measure should be defeated. It cannot be intended for any good purpose, and its pernicious effect would be felt by every quasi-public corporation in the state.

Bell Telephone Business in the West in 1896.

Two important western telephone companies licensed by the Bell company—the Chicago and the Central Union—held their annual meetings last week. The former did better than was expected in the middle of the year, while the latter showed a notable decrease in net earnings, due, no doubt, to the competition of the hundreds of small independent companies scattered throughout the Central Union's territory.

The Chicago Telephone company, during the year 1896, earned a total of $1,955,829, and had expenditures of $1,355,624, leaving the net earnings for the year $600,205. During the year the capital stock was increased from $3,796,200 to $4,336,500. The earnings for the year were at the rate of 13.84 per cent. upon the increased capital.

The figures presented by the president were as follows:

	1895.	1896.
Gross earnings	$1,759,752.34	$1 955,829.03
Expenses	1,216,913.68	1,355,624.05
Net earnings	$ 524,838.66	$ 600,204.98
Dividends paid	455,544.00	499,224.00
Surplus for year	$ 87,294.66	$ 100,980.98
Jan. 1, 1896—Capital stock outstanding		$3,796,200.00
New stock sold during 1896		540,300.00
Jan. 1, 1897—Capital stock outstanding		$4.336,500.00

There were represented at the meeting, either in person or by proxy, 37,913 shares of stock out of a total of 43,365 There was no opposition to the regular nominations for directors of the company, and they were elected as follows: J. Russell Jones, Henry B. Stone, Norman Williams, Robert T. Lincoln, John De Koven, George M. Pullman, Arthur G. Fuller, C. E. Perkins, William A. Jackson. About 15,000 telephones are connected with this company's exchanges. Of these 13,000 are in Chicago and the remainder in Joliet, Aurora, Elgin and other outlying and suburban exchanges in the company's territory, which includes the northeastern corner of Illinois and very small portions of Wisconsin and Indiana.

More interest, perhaps, centers in the report of the Central Union company, as it has to withstand the brunt of the anti-Bell crusade in the West. President H. B. Stone's report is given in full:

Below is given a table showing a comparative statement of the gross earnings and expenses of the years 1896 (partly estimated) and 1895:

	1896.	1895.
Gross earnings	$1,327,931.88	$1,345,711.29
Expenses (exclusive of interest)	1,026,311.40	971,091.72
	$ 301,620.48	$ 374,619.57
Interest	64,520.75	23,124 12
Net revenue	$ 237,099.73	$ 351,495.45
Dividends paid	66,053.00	330,265.00
Surplus	$ 171,046.73	$ 21,230.45

In 1896, in addition to regular maintenance (repairs and ordinary reconstruction) there has been expended on extraordinary reconstruction, $118,822 05, which will be charged into expenses in maintenance account before the closing of the books. There has also been expended in new construction, approximately, $700,000, of which $425,000 has been expended at exchanges, and $275,000 on metallic-circuit toll lines. The principal exchange work has been at Toledo and Columbus, Ohio, and Indianapolis, Ind.

At Toledo, Ohio, an underground plant in the center of the city has been put in and the entire aerial plant of the company remodeled and practically renewed. This work is now complete, and the service is being given through the new plant in the most satisfactory manner to all concerned.

At Columbus, Ohio, an underground plant has been put in and the whole exchange practically rebuilt and brought up to the conditions of the best practice. Work at Columbus is substantially complete, and it is expected that service will be given through the new plant by February 1st next.

At Indianapolis, Ind., underground conduits and street vaults have been completed, and a building has been purchased which will afford adequate quarters for the switchboard and other operating appliances and necessary offices. The work at this point contemplates, as at Toledo and Columbus, an underground plant in the center of the city and the reconstruction of all the aerial plant, together with a new switchboard, which will make this exchange one of the very best in the country. There is a good deal of work still to be done at this point, and it will probably be the first of next December before the new plant is entirely complete.

The plant during the year has been very largely increased in many other exchanges and some new exchanges have been opened, the number now operated being 132, and the company now has a foundation plant in its existing exchanges, sufficient to provide for an increase of subscribers up to 50,000.

During the year there have been completed, approximately, 5,000 miles of wire of toll lines—lines between towns connecting exchanges—making the total number of miles of wire now in operation nearly 18,000, two-thirds of which are copper-metallic circuits of the most modern type. These facilities, in connection with the lines of the Long-distance company, afford means of intercommunication between the cities and larger towns in almost all of the country lying between the Mississippi River and the seaboard. There should be, however, in this year, considerable increases to these toll lines, particularly in the state of Illinois, in order to make the system sufficiently complete to meet present requirements and those of the immediate future.

A first mortgage of $3,000,000 was placed on all the property of the company on the first of July, 1896, and the sale of $1,600,000 of gold six per cent. bonds under this mortgage authorized, to clear up the then existing floating debt of the company and to provide further funds for construction purposes. Of these bonds $1,275,000 have been sold and paid for at 97½, leaving $325,000 of the authorized issue unsold, in the treasury of the company. At the close of 1896 there was a total unfunded debt of $400,000. Against this there was the $325,000 of unsold bonds, and $98,000 of storehouse stock, all good for immediate use and standing on the books at a little less than its actual present value. This storehouse stock was larger than the normal, the excess being made up of poles, cables and other line material purchased for the completion of the Indianapolis and other plants.

There was, in 1896, a considerable net gain of exchange subscribers, but the number of competing exchanges in towns where this company was already established was so great as, for the time, to largely nullify the expected increased earnings from this source, by forcing rates below the cost of doing the business. This competition has been largely inspired by promoters, and is based on entirely wrong estimates of the cost of doing the telephone business; but while it lasts, it is, from its ignorance, the more severe. Most of the competing exchanges which have been in operation for any length of time have insolvency directly in front of them. In many cases this is realized by their owners, although by no means to its full extent. Nowhere has the opposition been able to give as satisfactory service as this company, and in most cases their service is greatly inferior. As yet the opposition only have toll lines radiating from a few of their larger exchanges, but nothing which is comparable to the state and inter-state service given by the metallic circuit toll lines of this company and the Long-distance company.

For completing the construction work at Indianapolis, for enlarging certain existing and building some new exchanges, and for connecting new subscribers, will require this year, say $600,000. If net earnings to the extent of $200,000 are devoted to this, and additional bonds are sold, bringing the total amount outstanding up to $2,000,000, all this work will be accomplished, and the end of 1897 find the company out of debt, except its bonds, with the whole of its territory well covered with a plant of the most modern character, practically new, its average age being about three years. Its earning capacity should then be sufficient to fully maintain its property at the highest standard of efficiency, pay interest on its bonds and leave a good surplus.

A revival in general business will immediately give the company a large number of new subscribers and an increase in its toll business, which it is fully equipped for and able to do at the minimum of expense. To the superior quality of its plant and service, both in its local exchanges and in its toll lines, the company can confidently look for success in the future. To fully achieve this, the number of exchange telephones should be increased as rapidly as possible by offering service of any desired kind and at the cheapest possible rates. There should also be, as has been stated above, a considerable increase in the toll lines, particularly in Illinois. The territory is all good, and will be a paying one if the company holds it and develops it. But it must be completely occupied.

The capital stock outstanding is $6,605,300. The expenses, including interest, were 82½ per cent. of the earnings. The stockholders elected as directors C. H. Brownell, R. C. Clowry, C. R. Cummings, Arthur G. Fuller, F. H. Griggs, W A. Jackson, J. Russell Jones, M. G. Kellogg, Henry B. Stone, John F. Wallick and Norman Williams.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Mississippi Valley Telephone company, of which J. C. Hubinger of Keokuk, Ia., is the backer, is an applicant for a franchise at Burlington and at Davenport, Ia.

The Standard Telephone company has agreed to put in a telephone exchange at Decorah, Ia., if 150 subscribers are secured. Over 100 pledges have already been taken.

Rochester, Minn., is connected with the Northwestern Telephone Exchange company's system.

The new telephone exchange has been put in operation at New Ulm, Minn.

Roy Hopkins has purchased the telephone exchange at Redfield, S. D.

The new Mutual Telephone company at Des Moines, Ia., will ask the council for a number of privileges not given the old company, such as overhead wires, etc., which will produce a vigorous "kick" on the part of the present company.

The Wisconsin Telephone company will make long-distance connection from Ashland, Wis., to Duluth.

A temporary scaffolding caught fire from a portable forge in Davenport, Ia., and melted two telephone cables with about 200 wires. The damage was about $200.

Movement to Further Independent Telephone Competition in Massachusetts.

The movement to compel Bell companies to afford competitors the use of their lines seems to exist in the East as well as in the West. The Boston correspondent of the WESTERN ELECTRICIAN writes: "Two significant petitions were received in the lower branch of the Massachusetts Legislature. Both relate to telephone companies. Representative P. J. Kennedy of Holyoke is father of both of the petitions. In the first instance he petitions that all companies engaged in the business of transmitting telephone messages or leasing or renting telephone instruments or wires in this commonwealth shall, on request of any other company or corporation engaged in a similar business in this commonwealth, furnish said company or corporation with the use of its wires and instruments for the purpose of allowing the subscribers on one company to hold conversation with the subscribers of the other company; the compensation for the use of such wires and instruments to be fixed as the Legislature deems proper.

"His second petition is as follows: 'That the rentals and tolls of the companies or corporations controlling the service of a telephone communication in the commonwealth are unreasonable and excessive. The petitioner therefore prays for such legislation as will provide for a more reasonable rental or toll charge for telephone charge in this commonwealth, or, if, in the judgment of the Legislature, it may be deemed advisable, that a commission be established to consider and regulate all matters pertaining to telephone service in this commonwealth, for such legislation as will provide for such a commission.'"

Independent Telephone Companies of Indiana.

The representatives of 35 of the 45 independent telephone companies of Indiana met in Fort Wayne on January 19th to effect a state consolidation or combination of all independent companies to extend the toll line service and long-distance connections. This is to enable the new companies to compete on an equal footing with the Bell company. The new companies propose to reach every point of importance in the state, with connections in Ohio and Michigan. Judge R. S. Taylor, one of the government counsel in the Berliner suit, addressed the meeting for two hours on patents and improvements in the telephone business. It was decided to hold a meeting at Indianapolis in two weeks to prepare papers for the consolidation and to elect permanent officers.

Proposed Illinois Telephone Association.

On January 21st there was a meeting at the Western Telephone Construction company's office of the independent telephone exchange men who operate exchanges in the state of Illinois. The purpose of the meeting was to create a standard for toll-line construction, which is becoming a very important matter in this state. The combined interests of those present represented over 4,000 miles of toll lines. After appointing a committee of three to organize a state association the meeting adjourned, subject to the call of the committee.

The committee in charge of the project consists of C. M. Brock of Fairfield and C. P. Platt and James E. Keelyn of Chicago.

Cheerful New Year's Sentiment.

In common with many other technical journals the London *Electrician* adheres to the time-honored New Year's custom of reviewing the year past and forecasting the year to come. Essaying this task for 1896 and 1897 it makes the following generous observation:

There is plenty of electric tramway work ahead; and if English manufacturers allow others to secure the best contracts, they will only have themselves to blame. Not a single American pole, not a pound of American plant, should be their motto.

According to the London *Electrician* there are translating devices connected to the central stations of Great Britain and Ireland equivalent in capacity to over three million lamps of eight candle power each. Of this, 1,462,000 lamps' capacity is in London and 1,602,000 in the provinces.

Protection Devices for Transformers.

[*Continued from page 59.*]

transformer will not be sufficient to pay for the coal used in generating the current to supply the iron core loss, Therefore it will be most economical to scrap such transformers.

This test should be made as frequently as possible, and at least once a year. When making this test, the secondary should be connected with the iron core, as this acts as a condenser and a high-potential current would be generated in secondary wires, which would burn out the insulation between secondary wires and core.

Transformers are not generally tested for leakage between primaries and secondaries, and as they are isolated on the line, there is no means of testing for leakage at the central station without extra wires. It is apparent that it is necessary to make frequent tests of this kind. An interesting method of testing transformers has been in operation at Great Falls, Montana, for the past two years. The secondaries of half a dozen transformers are connected to a common test wire, which is run to the central station, and tests are frequently made there between this test wire and each side of the primary circuit. The normal primary current of 2,080 volts is used for testing.

A fatal accident and several cases occurred where persons had received severe shocks, and for this reason the electrical engineer in charge was most anxious to keep his transformers in good condition. A test made on transformers on the line disclosed the fact that three or four of the transformers had primary and secondary coils in contact. All these transformers were not insulated with oil. Since using the test wire the system has been operated without accident, and a great saving of time has been effected by means of the test wire. It would seem that there might be many cases where this system would be of advantage.

A fatal accident can only occur when the following connections are made:

First—A ground on one of the primary wires.

Second—A leak between primary and secondary on the opposite side of the system on which the ground is located.

Third—A person in circuit with the secondary and ground. As the majority of lamps are installed in locations where it is impossible to get a connection to ground, many chances of receiving fatal shocks are avoided. If the primary lines are kept free from grounds no shock can be obtained. It is, therefore, essential to use the most approved appliances at central stations for indicating grounds on primary wires.

The most common ground detector in use at present consists of a transformer, the primary of which is attached to the line to be tested and the ground. The secondary winding of the transformer is in circuit with an incandescent lamp. The ground is indicated by the brilliancy of the lamp. This seems to be a very crude method of indicating grounds, as there is an opportunity of error, and the detector is connected only at stated periods. It has been said that alternating lines always have a slight ground, as the ground lamp always burns at a dull red. This is due to the capacity effect of the lines, and not to actual leakage of primary current.

The transformer system can be greatly improved in the following manner:

First—There should be used at the station and on outside lines short-gap lightning arresters that will permit the passage of the current across the gaps before the insulation of the transformers will be broken down.

Second—Transformers operated on 3,000 volt circuits or less should be constructed to stand a high-potential test of 7,500 to 10,000 volts for 60 seconds between primary and secondary windings.

Third—A safety device should be used in connection with transformers, that will prevent any difference of pressure in excess of 300 volts between secondary wires and ground.

Fourth—Transformers should be filled with oil.

Fifth—Transformers should be periodically tested for insulation between primary and secondary, with high potential currents.

Sixth—A ground detector which will positively indicate a leakage of current from primary wires to ground should be used at the central station. It should not be affected by the capacity effect of lines and it should be designed to be left permanently in circuit.

DISCUSSION.

F. McMASTER of Chicago: I would like to inquire how the grounding core is arranged so that there are no losses from induction in the protective device.

MR. WIRT: The shield is a sheet of copper, and the ends are insulated so that there is no current passing in the shield. If you made a complete loop around the core of course there would be current wasted in the shield.

MR. PIERCE of Chicago: What kind of a device could be permanently left in the circuit in order to show the ground which we could use there that would not cause trouble in some other way?

MR. WIRT: A static instrument can be used something like Sir William Thomson's static voltmeter. Each line will form a coil, and the capacity effects of line will balance, and if there is a leak the differeoce will be measured by an indicator. In the course of six weeks such an instrument will be on the market.

PROF. W. M. STINE of Chicago: I would like to ask Mr. Wirt if there is any scientific connection between the high core loss and the low insulation in the second wire. Is one the consequence of the other if you continue the excessive heating?

MR. WIRT: There is no scientific connection between the two. I merely wanted to make it as easy as possible for the gentlemen to take off their old transformers.

W. W. BEAN of St. Joseph, Mich.: If Mr. Wirt wants to make it as easy as possible for the gentlemen present to take off their old transformers, I hope the chair will not let this argument close until every electrical engineer is heard from, because we want to know something about the transformers before we buy them. If you know any other electrical engineers besides Mr. Pierce and Mr. Stine, let us hear from them. We are here for business, it seems.

MR. WIRT: I might say that in the case of a transformer supplying my house, which has been in operation 16 months, I wanted to find out how much money the central station had made. I took the bills for 16 months down and measured the core losses and found that the central station had made just enough money to pay for fuel for core losses, to say nothing of the energy lost in supplying the lights; so that you see it is a very important subject to look into.

CARYL D. HASKINS of Boston: I think there might be some connection between the poor insulation and core losses. Poor insulation may result in heating, which may very readily break down such insulation as is used in insulating the plates of the cores, one from the other, and that would cause increased current losses; so I think Mr. Wirt's point is very well taken.

Convention Notes.

George Langstaff Thayer of Belle Plaine, Ia., was one of the ubiquitous.

Julian Roe, acting for Sargent & Lundy, Chicago, "held up his end."

F. H. Ford of Madison, Wis., could not resist the temptation—he came too.

T. A. Pamperin drifted down from Oconto and managed to enjoy himself hugely.

Where were S. F. B. Morse and Messrs. Chandler and Brooks? Oh, they were missed!

The electrical press was represented by Messrs. Sullivan, Summers, Church, Smith and Perry.

W. C. Shaffer of Milwaukee found time to renew his many old acquaintances in the electrical field.

Treasurer Chas. H. Rockwell of the Buckeye Electric company found time to drop in on the boys.

Hart switches and Geo. S. Searing, as usual, went "hand in hand," if the expression will be allowed.

S. G. Coleman and H. F. Boggis of the Milwaukee Electric Railway & Light company were on hand in the rotunda.

W. S. Hine of the Wallace Electric company found time to spend a couple of days in Milwaukee during convention time.

John Child was not one of the "children," as far as mica is concerned. Even "Little Willie" couldn't approach him on sales.

It was a matter of regret that the Messrs. Conover and Goe, of the newly organized Conover-Goe company of Chicago, were unable to attend.

J. S. Maurer of the Crouse-Tremaine Carbon company of Fostoria, Ohio, mingled with the boys in the rotunda. Mr. Maurer is an energetic salesmen.

Geo. F. Rohn of Rohn & Myers, electrical engineers, Milwaukee, was a reminder that his firm has recently installed a fine electric plant in the Uhlein Theater.

W. H. Grissom of the Eureka Tempered Copper company, Chicago, was on hand throughout the entire gathering, coming up with the boys from Chicago on the convention train.

President Willard W. Low of the Electric Appliance company, in company with his energetic hustling lieutenant, F. McMaster, kept things warm for the Electric Appliance company.

L. W. Kittman of the Chicago General Fixture company made himself felt in his usual manner. Mr. Kittman has done most excellent work throughout the Northwest for the General Fixture company.

Of course Whyte, of the Leschen-Macomber-Whyte company, Chicago, was on hand. Mr. Whyte is one of the lights of the convention, and, as was remarked, "what would the convention be without Whyte?"

W. R. Brixey of New York was there, too, but he didn't stay long enough, for Mr. Brixey has numerous friends in the West, and there were many that would have liked to have had a chance to entertain him when at Milwaukee.

Of course "McGill" was there, and right welcome he was, too. Mr. McGill is one of those genial electrical representatives whose companionship is always in demand. He is not only a good salesman, but also a thoroughly good fellow.

Electrical Engineer A. M. Patitz was one of the Milwaukeeans that took considerable interest in the convention. Mr. Patitz was unable to be in constant attendance owing to pressure of business, but his many friends felt that the "spirit was willing."

Where was popular Herman Andrae? He must have been around and a few undoubtedly saw him; still there were a number who wished to see more of him. However, Mr. Andrae is one of the busiest men in the Northwest, and although he is a thorough believer in conventions, and is as fond of mingling with the boys as any one, still he is a man who always puts business before pleasure.

Habitual convention-goers would miss the genial countenance of M. E. Baird, and sure enough this time he turned up. The Eddy Electric Manufacturing company certainly has a "hustler" in the person of Mr. Baird, and his work is undoubtedly felt all over the country.

Chicago Agent D. Graeme McDougall of the Washington Carbon company came to the front with flying colors. Mr. McDougall is not only an excellent salesman, but is a polished gentlemen as well, and in company with Manager Crider did the honors very creditably indeed.

Western Manager J. M. Hill of the Bryan-Marsh company was the recipient of congratulations on all sides over his recent connection with the Bryan-Marsh company. Mr. Hill has gained an enviable reputation, but he has earned it through hard and skillful work as a salesman.

It was a matter of great regret to the many friends of Purchasing Agent Charles Holmes of the Chicago Edison company that he could not be present at the Northwestern Electrical association convention at Milwaukee. Mr. Holmes is a man of many friends, and his presence was greatly missed.

W. H. Gray made no exhibit in the interest of the Peckham Motor Truck & Wheel company but he did make, through his courteous treatment of all those with whom he came in contact, many friends for not only his company, but himself as well. The company will hear from his work without doubt.

It is said that Geo Cutter takes an interest in local politics in Chicago's suburbs, and if his speeches at home are as happily turned and create as much enthusiasm as the one on "Chicago" at the banquet, it is fair to presume that we will have to change his name from "George" to "Chauncey."

J. S. Crider of the Washington Carbon company of Pittsburg was about the Pfister during the sessions of the convention. Mr. Crider, although not on the road regularly, is one of those energetic managers that believes in seeing for himself, and, for that matter, selling for himself to a large extent.

The genial countenance of H. D. Latimer was missed from the convention, but was certainly not forgotten. Mr. Latimer's business card, which stated that he was in the brokerage business in Madison, was attached to a sign of the People's Electric company as a reminder to the boys that he was still "with them."

Among the wire representatives appeared Secretary and Treasurer Wm. M. Smith of the Chicago Insulated Wire company. Mr. Smith has of late been quite a regular convention attendant in the interest of his most excellent wire, and was decidedly in evidence at the recent street railway convention in St. Louis.

The Metropolitan Electric company, Chicago, appeared in the person of Walter C. McKinlock. Mr. McKinlock paid especial attention to introducing an overhead joist-boring machine, and also the new Metropolitan oil filter. It was a matter of regret that President W. H. McKinlock was unable to be present.

Manager Charles E. Gregory of the Elliptical Carbon company of Chicago and Cleveland held up his end in that peculiarly successful manner for which he is noted. Mr. Gregory's success with ellipitical carbons has already made him a reputation in the carbon field, but he always did manage to appear in the front rank.

There were few people at the convention who will deny "Billy" Buckley credit for a fair knowledge of how to gracefully and forcibly represent his old standby, the Fort Wayne company, at such a gathering. The Fort Wayne company would have to look a long way before it could find for a champion a better combination of geniality and brightness.

The many old friends in Chicago and throughout the West of W. L. Church, who was for so long the superintendent of the Chicago Edison company, extended greetings. Mr. Church has been pronounced one of the brightest and most thoroughly experienced central station men in the United States and his friends are gratified at his success in Milwaukee.

M. B. Austin, the gentlemanly and energetic western manager for the Safety Insulated Wire & Cable company of New York and Holmes, Booth & Hayden, Waterbury, Conn., as usual "did" the convention in the most approved manner. It is safe to say that Mr. Austin rarely misses a convention, and his work there and throughout the West is strongly felt.

General Agent J. P. Williams of New York came up from Chicago to remind the convention of the remarkable record already attained by the new Paragoo iron-clad motor. Mr. Williams has just closed a contract with the Chicago Edison company for the introduction of the Paragon motor in Cook county, after exhaustive comparative tests by that company.

General Manager M. C. Wheaton of the Stromberg-Carlson Telephone Manufacturing company came up on the convention train and made a most interesting exhibit at the Pfister of his company's splendid telephonic equipments. Long-distance telephones were shown, as were instruments for central exchanges; also desk sets, magnetos, signal bells, inter-communicating interior systems, etc. Taken all in all, Mr. Wheaton's

trip must have paid him as an advertisement, from the fact that he has been for years so well known throughout the Northwest.

F. S. and A. S. Terry as usual appeared in the interests of the Sunbeam Lamp company. The former is now away from home a great deal of his time, and works in conjunction with his brother at the Chicago end of the line, in the interests of the lamp, as well as for the Cutter Electrical Manufacturing company of Philadelphia and the Lakon company of Elkhart, Ind.

Among the Milwaukee men that mingled with the boys were President L. T. Gibbs and Vice-president Frank R. Bacon of the American Rheostat company of Milwaukee. This company is a comparatively new Milwaukee institution, but the men in it are thoroughly conversant with the business, and it already has done a most satisfactory business and one that indicates a bright future for its goods.

That courteous representative, W. D. Mahaney of the Graphite Rheostat company of Chicago, through his genial and hearty treatment of all those with whom he came in contact, made a host of friends for his company's most excellent specialties, among which may be mentioned Wheatstone bridges with novel features, graphite rheostats, theater dimmers, starting boxes, etc. Mr. Mahaney was once a newspaper man.

Western Manager Fred P. Luther of the American Electric Heating corporation, 1644 Monadnock building, Chicago, exhibited a handsome and interesting line of electric heating apparatus. Mr. Luther is an old heating expert, and he feels that the electric heating business is developing at a rate that is most encouraging; he has already done a most excellent business since his establishment at the Chicago end of the business.

Treasurer and General Manager A. Louis Kuehmsted of the Chas. E. Gregory company was "everywhere." Mr. Kuehmsted came up on the train with the Chicago delegation, and someone whispered he managed to close quite a handsome order while in Milwaukee. Mr. Kuehmsted was to be found in the center of almost every jolly party, and his popularity, without doubt, will be a decided advantage to his company in a business way.

"Western Electric" Wilkinson had the audacity to state that he did not intend to appear at the Milwaukee convention, but nobody paid much attention to that, and sure enough the Western Electric company was represented in its usual able manner, and, strange to say, by that very same "Western Electric" Wilkinson. Wilkinson certainly would have been missed had he stayed away, for there is no man for whom there is a kindlier feeling.

It was expected that General Manager Fox of the Northern Electrical Manufacturing company of Madison, Wis,, would run down to attend the convention. The Northern company recently made a large sale of its motors in Milwaukee after the most heated competition, and the plant when finished will doubtless be one of the largest in the West. Buyers of motors, especially in the West, might find it to their interest to correspond with Mr. Fox.

"Ferris," the recently appointed "General Electric man," with headquarters at Milwaukee, did himself proud (as all newspaper men will be willing to bear witness) in his energetic and successful effort to have the convention keep the "G. E." company thoroughly in mind. Mr. Ferris has not been long in this territory, but it is fair to prophesy that it will not be long before his energetic work will be felt in a way greatly to the benefit of his company.

That new and very popular combination, or "team," as it is called throughout the Northwest, Donley & Bunce, was decidedly in evidence. These gentlemen have an exceedingly fine line of agencies, and it must have been a decided pleasure to them to receive the multitudinous good wishes and congratulations on a step which, it is generally prophesied, from the great popularity and recognized ability of the principals, cannot fail to be successful.

Electrical Engineer Goltz of Goltz & Sinclair made an exhibit, but Mr. Goltz was particularly prominent through his energetic efforts in extending the hospitality of Milwaukee to the visiting members. Incidentally it may be said that few outside of the newspaper men fully realize the time and hard work expended by Messrs. Mercein, Bunce and Goltz to make the stay of Milwaukee's guests a thoroughly pleasant one. These gentlemen "worked the wires" well, with the very best results.

One of the features of the banquet was the presentation to Thomas R. Mercein of a token of appreciation subscribed for by his many personal friends of the association. The handsome badge was handed to Mr. Mercein by James Wolff after a happy and neatly turned little speech and was accepted by Mr. Mercein in his characteristically graceful manner. Mr. Mercein well merits the characterization so often applied to him after banquets and other entertainments, "silver-tongued."

Secretary and Treasurer A. C. Garrison of the Columbia Incandescent Lamp company of St. Louis, in company with Manager of Sales E. H. Abadie of the Wagner company of the same city, represented St. Louis in a manner which was a credit to that hospitable and attractive city, so noted for its courtesy to strangers. Mr. Abadie's exhibit is described elsewhere in this issue. Mr. Garrison, however, brought with him samples of a 220 volt lamp of different styles and a street railway lamp. He also exhibited a line of raw lamp material in the shape of the substance of which filaments are made. This substance was shown in different stages from the liquid mass up to the carbonized filament and made an exhibit of decided interest to thinking incandescent lamp buyers.

Some one remarked that Wormley was never last in the lamp trade as far as orders are concerned. James C. Wormley & Co. is a firm that during the last year has made itself felt throughout the West and Northwest and especially in Chicago. Mr. Wormley is a most convincing salesman, and, with goods of a high grade, his work for the Wormley lamp has been most successful. His recent move in the way of discounts has served as a reminder to the trade that he is always to the front, where fair treatment of the consumer is concerned.

It was a matter of regret that President John H. Myers and General Manager A. B. Ferdinand of the Northwestern Telephone Manufacturing company of Milwaukee were prevented through urgent business out of the city from visiting the gathering at the Pfister. The Northwestern Telephone Manufacturing company is said to be doing a most excellent business, and from the fact that the management is so frequently out of the city it is but reasonable to presume that their business is flourishing.

Secretary and Treasurer T. S. Lane of the Electrical Exchange, Chicago, joined the crowd at the Union depot and came with the Chicago contingent to Milwaukee. Mr. Lane is a most energetic worker, and his aggressive, yet withal thoroughly businesslike and gentlemanly efforts as manager of his enterprise, have built up a business unique, and one that has had a remarkable growth. Quiet and unassuming and thoroughly "business," Mr. Lane made his presence felt at the convention in the most favorable manner and won a host of friends for the Electrical Exchange.

It was a matter of great regret on the part of the many friends of the Commercial Electrical Supply company of St. Louis that Vice-president Joseph Franklin, Jr., and Manager of Sales Paul D. Cable could not be present at the convention, owing to pressure of work at the home office. However, "Little Willie" and the "Old Man" made many friends for the company, and although they made no effort to sell goods, the smiles on many faces on board the convention train and throughout the Pfister at Milwaukee over their queer antics were indication enough of the fact that the Commercial company is rapidly adding to its already large list of strong friends.

It was evident early Wednesday morning of last week, when the delegates assembled at the Northwestern depot of Chicago, to take the Northwestern convention train for Milwaukee, that the high spirits so essential for a convention's success were there to an extent that seemed to bid fair for a most successful gathering at Milwaukee. It was remarked, too, after the gathering that this convention was by far the most successful, particularly as far as business was concerned, of any thus far held. Members kept close to work, and the manner in which the various issues were handled indicated that the association has interests decidedly paramount, and those that it will pay every Northwestern electrical central station man to spend the time and thought to consider.

President L. W. Burch of the People's Electric company of Madison, Wis., is one of the staunchest believers in the Northwestern Electrical association; he has never missed a convention yet, and this time found him with Manager Doherty of the Madison Gas & Electric company doing the honors for the Capital City. Mr. Burch's enterprise has been successful, and it is safe to say there is no one that receives from the boys a better line of hearty good wishes and substantial encouragement than Burch. Speaking of Madison at a Northwestern convention cannot fail to bring to mind the energetic efforts of Manager Doherty of the Madison Lighting company. Mr. Doherty is truly a "fighting representative" in his efforts against municipal encroachment. With all his aggressiveness, however, he never loses his head or his temper; hence the respect with which he is treated and his rapid rise to prominence in the association.

Quietly and without undue excitement the two energetic and business-like representatives, Chas. J. Burton and W. P. Upham of the Central Electric company, Chicago, immediately on arrival proceeded to "get there" in a manner that showed conclusively that they were men of experience at electrical conventions. Mr. Burton is known in some quarters as the Central Electric company's "X-ray" expert, and it was noticed by those who realized the value of an opportunity that Burton's X-ray slides made in the interest of the Central Electric company were shown on the screen immediately after Mr. Haskins' lecture, and caused no little complimentary comments on the excellence of the work obtained through the Central Electric company's X-ray apparatus. It was a matter of regret that neither President Geo. A. McKinlock nor Secretary and Treasurer Chas. E. Brown could be present. Mr. McKinlock was at the time out of the city on business, and Mr. Brown was detained, owing to the pressure of business at headquarters.

The General Electric company was represented by B. E. Sunny, western manager, and the following-named gentlemen: George K. Wheeler, Chicago; C. D. Haskins, Boston; H. C. Wirt, Schenectady; Percy A. Clisdell, Chicago; Thomas Ferris, Milwaukee. They exhibited a nice line of supplies in parlor No. 8, near the convention hall. A line of samples of the new Wirt alternating current short-gap lightning arresters was displayed, together with the new three-ampere and five-ampere long-burning arc lamps, type H transformer and Thomson inclined coil instruments, which were all favorably commented upon. The *Bulletin of the University of Wisconsin*, containing a report of the complete test of "Modern American Transformers," made by A. H. Ford, was distributed, together with other literature. The apparatus manufactured by the General Electric company for generating X-rays, as shown by C. D. Haskins, was the hit of the convention and elicited universal favorable comment. Mr. Haskins was the busiest man at the Pfister, and was ever ready to answer the many questions asked concerning General Electric X-ray apparatus. The great advantage of oil as an insulator was brought out very clearly by the fact that the very high potentials produced in the X-ray apparatus of the General Electric company were handled with absolute safety inasmuch as the X-ray transformers and kindred appliances were immersed in oil. This fact attracted much attention from delegates to the convention.

The Westinghouse Electric & Manufacturing company, in room 8, at the head of the grand staircase, exhibited a five horse power two-phase motor of 7,200 alternations and 110 volts. This motor has no brushes; the armature coils are short-circuited on themselves. This type is extensively used in Milwaukee on circuits supplied with current by the Pabst company. Current for the motor and other apparatus exhibited was supplied at 2,200 volts from special leads brought into the hotel from the street circuits. Passing through fuse boxes and a new and admirable type of junction box exhibited by Jacob Cloos, superintendent of the Pabst power plant, the current passed to two 25 kilowatt indoor type Westinghouse transformers, reducing the potential for the motor. There was also exhibited in operation several smaller indoor type transformers, on one of the new Niagara type Shallenberger integrating alternating current wattmeters. This instrument aroused much interest for its extreme accuracy throughout the entire range of load and for the promptness with which it starts on very light loads. The Westinghouse company guarantees these meters to start on one-tenth of one per cent. of full load. The accuracy of operation was shown by the switching on and off of incandescent lamps. There were also fan motors, economy coils, high potential fuse blocks, etc. A full line of catalogues and colored lithographs of the Westinghouse company's new factory at East Pittsburg was available and generously distributed. The representatives of the company from the Chicago office, 171 La Salle street, were W. S. Rugg, E. Dryer and Henry Floy.

An exhibit at the convention that created a most excellent impression, and was in fact one of the most novel there, was that of E. H. Abadie of the Wagner Electrical Manufacturing company of St. Louis, Mo. Mr. Abadie presented for the inspection of central station men a new alternating current ceiling fan. This fan, shown in actual operation in the Wagner parlor, is designed so as to operate at the same speed as a direct current ceiling fan. It has ball bearings which rest in a cup filled with oil to last under ordinary conditions of operation, say, 18 hours per day, it is claimed, for years without replenishing. There is but one bearing, which consequently does away with a great amount of fractures. The blades are attached directly to the revolving field and can be set at any angle desired. The switching device is extremely unique. It is located slightly above the motor proper and is operated by a handle, which is the oil cup for the bearing above referred to. The motor is started by a slight manipulation of the oil cup, continuous turning having the tendency to turn the motor first on and then off. It takes between 100 and 125 watts to operate this motor on 100 volts. It is claimed to be absolutely impossible to burn this motor out and it is guaranteed by the Wagner company to operate with ordinary care for a period of one year from date of purchase. It is adaptable to any height of ceiling. It is the intention of the Wagner company to manufacture a limited supply of these fans this year, but it has already secured a large number of orders for delivery for this spring. The Wagner company also exhibited the 20 light transformers, standard, type, also a number of Wagner switches. A quick-break "baby" switch was also shown and possessed a number of interesting features, that, however, must be seen to be appreciated. Mr. Abadie distributed among the station men a valuable souvenir in the shape of a transformer ink well.

American Institute of Electrical Engineers.

The one hundred and eleventh meeting of the Institute was held on January 20th, and President Duncan presided. Seventy-five members and guests were present. The topic for the evening was "Electrically Driven Vehicles," the discussion being opened by A. L. Riker and participated in by Messrs. Duncan, Reckenzaun, Coho, Corson, Adams, Duryea, Sachs, Van Hoevenbergh and Pope.

At the meeting of the executive committee in the afternoon the following-named associate members were elected: Putnam A. Bates, New York; John Louis Hermessen, Berlin, Germany; Ludwig Hommel, Pittsburg; William R. Kenan, Jr., Sydney, N. S. W.; Willard H. MacGregor, New York; Calvin Winsor Rice, Winchester, Mass.; Francis Arthur Rich, Auckland, New Zealand; D. Franklin Stakes, Fort Wayne, Ind.; Samuel G. F. Townsend, New York.

The Electrical Exchange, Chicago.

In view of the rapid progress that has been made by this institution, electrical people in general will be interested to know more specifically the exact nature of the business carried on under its auspices. And although the Electrical Exchange already carries on its books a remarkably large list of steady customers, still it is fair to presume that there are many of them and others in the trade that have not an exactly clear idea as to the full scope and the details of the working of the establishment.

The Electrical Exchange began operations early in '96 as a brokerage house in electrical bargains. The original intention of the promoters was to handle second-hand electrical apparatus on a purely commission basis. The originators of the plan believed that if a medium could be established through which buyers of electrical apparatus could be put in communication with each other,

THE ELECTRICAL EXCHANGE.—EXTERIOR OF HEADQUARTERS.

the result would prove of benefit to every progressive buyer of electrical machinery, as it was believed that 75 per cent. of the second-hand electrical machinery thrown on the market is displaced by machinery of larger capacity, and is removed because of increasing business and not because it has become valueless. It is also often found that a very small repair bill will put a service-worn machine in as good condition as the day it came from the manufacturer. In the making of the second sale the Electrical Exchange believed that it had a plan by means of which the heavy cost attending the first sale would be reduced to a minimum, for it often occurs that the actual expense of selling new apparatus exceeds the shop cost. Such a plan, it was believed, could be made a permanent success only through the co-operation of central station men and buyers of electrical material in general; hence the name, "exchange."

The electrical fraternity is composed largely of progressive men, and they were not slow to realize the value of the plan proposed, and to-day the Electrical Exchange, through its price-sheet, is claimed to be in direct communication with nearly 12,000 buyers and sellers of bargain electrical apparatus. In fact the exchange considers it perhaps not a rash statement that it has more information relative to valuable bargains in its line at its command than could be contained in a modern encyclopedia.

The business enjoyed a rapid growth from its origin, and in time it was found necessary to carry a stock, and no better point could have been selected than at its home, Chicago. During the last year the exchange was successful in securing several stocks of electrical supplies at less than 50 per cent. of their actual value. It was figured that its patrons benefited by these purchases, and it is felt that a study of prevailing market prices of electrical material compared with the prices made by the Electrical Exchange will show a monthly saving to customers of thousands of dollars.

THE ELECTRICAL EXCHANGE.—GENERAL OFFICES.

One of the unique features of the Electrical Exchange is the fact that its president is a woman, C. L. Glasner, who was educated at Oberlin College and was private secretary to her father, Col. L. O. Gilman, during his term of office as United States marshal for the Circuit Court of Appeals. She has been identified with electrical interests for the last four years and takes an active part in the business of the Electrical Exchange.

The machinery department is under the management of R. Ralph Lane, and although this gentleman is young in years, he is credited with handling this department in a highly satisfactory manner. Mr. Lane is a thoroughly good salesman and his courteous and fair treatment of customers has without doubt contributed largely to the success of the Electrical Exchange.

The secretary and treasurer, and, in fact, the general manager of the exchange, T. Selby Lane, was born in Gustavus, Trumbull county, Ohio. T. S. Lane began operations at the age of sixteen as a wielder of the birch in an Ohio country school. Previous to his connection with the Electrical Exchange he was in the employment of the Warren Electric & Speciality company of Warren, O., for a period of three years as traveling salesman. During this time he covered the territory of 13 states and established a trade for the product of the Warren Electric & Specialty company and holds high letters of testimonial from his former employers. The entire general management of the business of the Electrical Exchange is in the hands of the secretary and treasurer.

The exchange has recently added to its business a thoroughly equipped repair department under the supervision of Gordon Jones. Mr. Jones comes to the exchange with an experience of seven years, four of which were spent with the Utica Electric Supply & Manufacturing company.

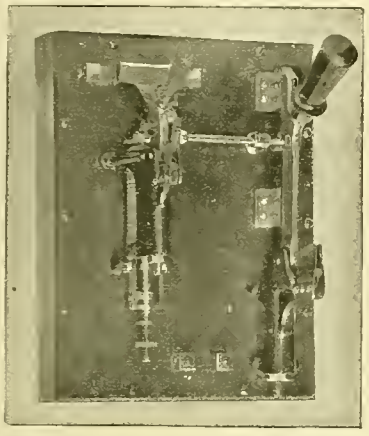
The exchange believes its success is due entirely to hard work and lots of it, together with liberal advertising. Its business has grown to large proportions, and as an evidence of this it states that in one month it has added to its list of customers nearly 400 new names. In new and commodious quarters, with ample facilities for handling all business that it secures, the Electrical Exchange believes that its prospects were never brighter.

THE ELECTRICAL EXCHANGE.—GENERAL SALESROOM.

The Southwestern Telegraph & Telephone company of Dallas will establish a telephone exchange in Gruesbeck, Texas.

Elden Alternating Current Circuit Breaker.

The accompanying cut illustrates an alternating current circuit breaker recently patented and now being brought to the attention of users of alternating apparatus by L. L. Elden, 305 Congress street, Boston The breaker is designed to be placed directly on the dynamos, in a position easy of access, and is quickly and easily connected in circuit. It is claimed that this device is a sure preventive for all the troubles that short-circuits, lightning discharges, etc., cause central station managers; and the record of the device, in stations where it has been in use, is reported to be an exceptional one. At a recent test of the breaker, at the station of the Boston Electric Light company, it was shown that the application of a dead short-circuit at the switchboard produced no visible effect on either engine,



ELDEN ALTERNATING CURRENT CIRCUIT BREAKER.

dynamo or belt, and, but for seeing the circuit breaker open, none present would have known that a short-circuit had been applied. All the alternating machines of this company were equipped two years ago with these breakers, after putting them to severe tests, and since that time the manager states that they have saved the company many times their cost and have never failed to operate in any case.

The adjustment of the breaker is accomplished by means of weights and fixed distances, with an entire absence of springs, making its operation absolutely reliable at all adjustments. This circuit breaker embodies a new device to prevent arcing at the switch jaws, which is certainly effective, as there is no sign of arcing when the breaker opens, even under very heavy loads to two to three hundred amperes. This breaker should prove to be of interest to all users of alternating apparatus.

Direct-connected Printing Presses for the New Germania Printing Company, Milwaukee.

The Northern Electrical Manufacturing company of Madison, Wis., is putting in an installation of unusual interest to electrical engineers in the West and Northwest, which will be located in the handsome new building of the Germania Printing company of Milwaukee. The new edifice is a massive eight-story structure of stone and brick of Italian renaissance style. It is the home of one of the largest and wealthiest publishing houses in the West. Its president, George Brumder, is well known throughout the United States as one of the solid old pioneers of western journalism. It has been the purpose of the engineer in charge of this building, A. M. Patitz of Milwaukee, to make it the most complete electrically of any printing establishment in the West. Simplicity, durability, economy and high efficiency of all machines are the salient features. The basement and two top floors of this modern building, of which an excellent engraving is shown in the advertisement of the Northern Electrical Manufacturing company on page xiii., are for the direct-connected presses, typesetting and bookbinding machines, run by direct-connected "Northern" electric motors. The intermediate floors are offices, single and in suites, to meet any requirements, and furnished with every modern convenience. The Northern Electrical Manufacturing company has extraordinary facilities for doing special direct-connected motor work, its entire works being new and up to date and fully equipped for the purpose, and it is especially fortunate in having a strong financial backing in its undertaking.

Cosmopolitan Electric Project.

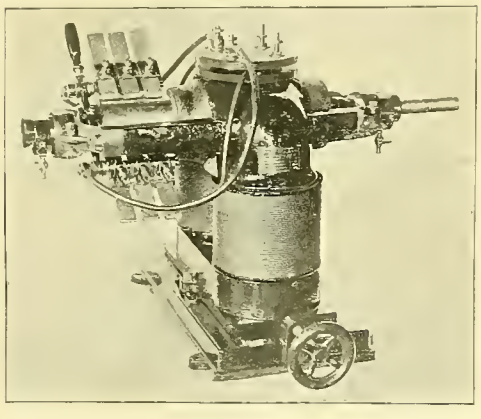
Commissioner of Public Works Downey has issued a permit to the Cosmopolitan Electric company, granting it permission to practically complete its down-town loop. The company is allowed to tear up Washington street from Halsted street to Michigan avenue and Michigan avenue from Washington street to Jackson boulevard. The latter thoroughfare from Michigan avenue to the river will be asked from the South Park commissioners, to complete the loop. The company is not to tear up the downtown streets until well along in the spring, and the commissioner has added a clause to the permit, making it compulsory upon the company to restore the streets to their original condition as speedily as possible. Attorney Levy Mayer, for the company, agreed to the condition.

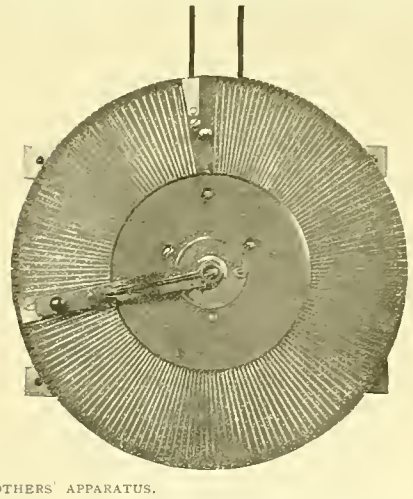
Opinion is divided as to whether this company actually contemplates the sale of current to consumers on a large scale. At the office of the Chicago Edison company the opinion is freely expressed that the Cosmopolitan company's *raison d'être* may be expressed in the word "sandbagging." On the other hand, there are those who say that the company has expended a large sum of money in laying wire ducts on the West Side, and that it is going ahead in good faith to enter the central station lighting business under the favorable auspices of an exceptionally liberal franchise. It is pointed out that the Ogden Gas company, backed by the same interests, is actually making gas, and that a similar policy may be expected from the electric company. Ex Governor Altgeld is reported to be the principal figure in the enterprise. Forée Bain is the electrical engineer of the company.

Roth Brothers' Apparatus.

The dynamo shown in the accompanying illustration (Fig. 1) is a two kilowatt machine, wound for 27 volts and 75 amperes, at a speed of 1,700 revolutions per minute It is run direct-connected to a Stanley induction motor and is used for charging storage batteries. The armature is surface wound and has but a low depth of winding. The commutator is large and has 32 sections. Two sets of three 1¼ inch brushes are provided to take off the current, and the brush holders are connected to the brush holder studs by flexible conductors, preventing the springs from heating and losing their temper. On account of the few armature conductors no sparking occurs at the brushes at any load. Gauze brushes are used. The machine is provided with self-oiling, self-aligning bearings with removable bearing sleeves. In a test made after the installation the efficiency was determined to be 85.8 per cent. The losses were distributed as follows: Watts loss at no load, 157; C^2R loss in armature, 127; load extra loss, 50; total loss (watts) 334.

For this particular work, in charging storage batteries,





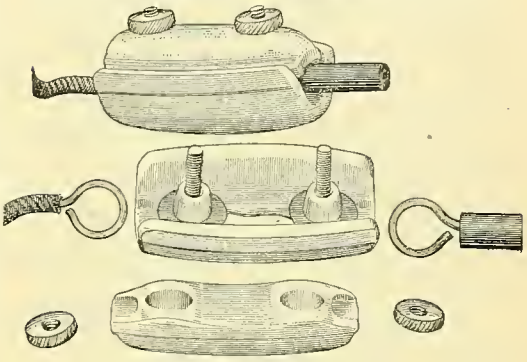
FIGS. 1 AND 2. ROTH BROTHERS' APPARATUS.

it is necessary to be able to change the voltage in very small steps. For this purpose a special field rheostat was designed, which is shown in Fig. 2. The resistance of this rheostat consists of German silver wire wound on a plate of slate having the shape of a ring. The contact lever bears directly on the wire and the number of steps is therefore equal to the number of turns of wire, which in this case is 180. The variation of voltage effected by cutting out one step is about one-tenth volt.

This outfit was manufactured for the Chicago Telephone company by Roth Bros. & Co., 32 Market street, Chicago, who make a specialty of machines for special purposes for outputs up to 10 kilowatts.

Reynolds Self-insulating Cut-out.

The Reynolds self-insulating cut-out is a radical departure from all other "bugs" and is believed to thoroughly meet every requirement of simplicity, safety and size. As shown in the cuts, no covering is required, as complete insulation is obtained when the connection is effected by the union of the two parts. Herein lies the special advantage and safety of the Reynolds cut-out. If can be connected up or re-fused quickly, and a ground with the fixture is impossible, as the clamping bolts are entirely encased in porcelain and thus are completely isolated from the circuit. Tape is useless with this device, which is an especially important point as regards safety. The Reynolds cut-out is claimed to be cheaper and smaller than any other covered "bug" on the market, and complies with the underwriters' requirements. The small size permits of a much smaller shell or canopy being used than heretofore; fixture manufacturers will appreciate this. S. K. Reynolds, 136 Liberty street, New York, is the agent for its sale.



REYNOLDS SELF-INSULATING CUT-OUT.

Reorganization of the Englewood & Chicago Electric Railway Company.

For nearly a year work has been under way for the storage battery road in the southern part of Chicago, which is building by the Englewood & Chicago Electric Railway company. The road is really under the control of the Electric Storage Battery company of Philadelphia, which is building it to exploit, under the most favorable conditions, the use of storage batteries for car propulsion. The franchise was purchased from W. V. Jacobs, whose name has recently come into prominence in connection with the troubles of the Calumet Electric Street Railway company and the National Bank of Illinois. In order to simplify the financial affairs of the company and to satisfy the bondholders that there is no legacy from the old management that will lessen the value of their claim, a reorganization was effected last week, and G. Herbert Condict was appointed receiver. The proceeding was of a friendly character and was taken in the United States Circuit Court before Judge Showalter. Stephen D. Bayer of New York, who is interested in the Electric Storage Battery company and also the holder of a $100,000 note of the Englewood & Chicago company, made in November, 1895, and on which there is a balance due of $12,200, brought the suit, and President Shaffer confessed the judgment. A deputy marshal served an execution upon Mr. Shaffer and he replied that the road was unable to pay the indebtedness. The bill for a receiver was already prepared.

The situation leading to this application for a receiver

for a road not yet in operation, or, at least, only to a limited extent, is thus explained by President Shaffer: There is an authorized issue of $2,000,000 of bonds, of which amount $1,000,000 has been issued and $700,000 sold. The road is almost completed, and will require $300,000 more to place it in running condition. The amount has been subscribed, but the subscribers do not want to have hanging over the road the authority to issue $1,000,000 more of bonds, and they agree to furnish the money required if the road is reorganized and the bonds limited to $1,000,000. The bondholders' committee is composed of President Shipley of the Provident Insurance company, J. S. Bache, Charles Heidelbach and Isaac L. Rice of New York.

Mr. Condict is well known as an electrical engineer. Until he came out from Philadelphia to build this road, he was chief engineer of the railway department of the Electric Storage Battery company. He was made general manager of the Englewood & Chicago company, and the entire construction and equipment of the road was placed in his hands. As receiver he has qualified by giving a bond of $50,000.

As has been shown, there is virtually no change in the management of the road, which is still backed by the big Philadelphia corporation. Work is going on steadily, although there have been various delays. It is now expected that everything will be in operation in March. Three of the new cars are now running, the batteries being charged from a temporary plant. Twenty-three trucks and eight car-bodies are on hand, and there is no difficulty in getting the parts of the rolling stock as fast as needed. The boilers have been in operation for some time, and about 22 miles of track has been laid. The engines are in place on the foundations, but the generators have not yet been received. The switchboard is completed, but has not been erected. The Arnold power system has not been installed, owing to delay in getting suitable quills for the clutches. The transfer table for the storage batteries is in operation, although some details of the complete equipment are lacking.

Metropolitan West Side Elevated Railroad Company in the Hands of a Receiver.

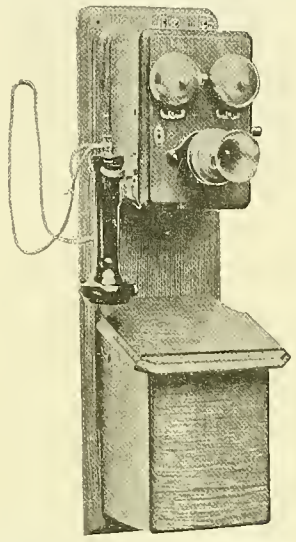
On January 20th Dickerson MacAllister was appointed receiver for the Metropolitan West Side Elevated Railroad company by Judge Showalter of the United States Circuit Court. Mr. MacAllister is the chief engineer of the company. A bill to foreclose the mortgage under which there is an authorized issue of $15,000,000 of bonds was filed in the federal court at the same time by John P. Wilson, who appeared as attorney for Adrian Iselin, Jr., and George G. Haven of New York, who were trustees for the bonds under the mortgage issued by the company on August 1, 1892. W. W. Gurley appeared as counsel for the Metropolitan company and admitted the facts set forth in the bill. This was a statement of the affairs of the company and set forth default in a portion of the interest coupons due August 1, 1895. Mr. Gurley admitted that the company was behind $37,000 in interest and would be unable to pay the interest on bonds due February 1st.

The Metropolitan people have always been very secretive about their financial affairs. They have a fine property, and as the company was the first to adopt electricity for power for permanent elevated railroad work in this country, the electrical fraternity will regret the receivership. However, it is to be borne in mind that the present misfortune was in no way due to the electrical equipment, but overtook the company in spite of it, owing partly to dull times and partly, also, it is to be feared, to reckless and speculative financiering. The road is now believed to be carrying between 50,000 and 55,000 passengers a day. Its operating expenses are practically 50 per cent. of passenger receipts. No statement has ever been given out as to the exact earnings or expenses of the road. Figured on a basis of 50,000 passengers and with operating expenses 50 per cent. the road would have net earnings of $456,250. It is said that the net earnings last year were $316,750.

There have been issued so far $10,000,000, on which the interest is $500,000 a year. A further issue of $5,000,000 in bonds is authorized, and the construction company had given notice that these will be issued February 1st. These will increase the interest charges of the road to $750,000 a year. In order to earn these interest charges the road would have to carry 75,000 passengers, figuring operating expenses at 40 per cent. It is asserted by people connected with the road that the operations around the loop would give the road an average daily traffic of 75,000 passengers, or an increase of 50 per cent. over the present traffic. There will be added to the fixed charges of the company for operating trains on the loop $62,500 as a minimum,

The trouble with the concern seems to be that it is top-heavy with securities. The *Chicago Tribune* gives this history of the road:

The Metropolitan West Side Elevated Railroad company was incorporated March 9, 1892, under the general railroad law of Illinois with an authorized capital of of $15,000,000. A. F. Walcott, the originator of the Alley "L," was the promoter of the enterprise. There was organized at the same time the West Side Construc-



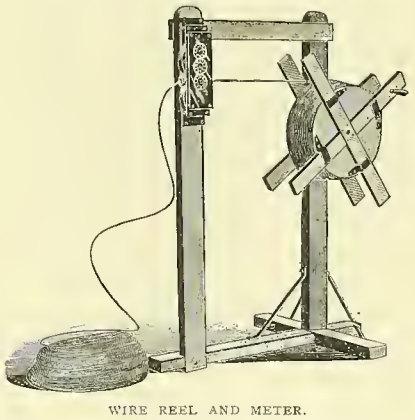
WHITMAN & COUCH'S NEW TELEPHONE.

tion company for the purpose of building the line. This company, which was in effect the same as the railroad company, had a capital of $3,000,000, and up to the present time the construction company has owned and controlled the railroad company as much as though there had been a single corporation instead of two.

June 15, 1892, $10,000,000 of the bonds of the railroad company were subscribed for at 90 cents on the dollar. There was a bonus of 25 per cent. in stock of the Metropolitan given with the bonds, and the subscription was a remarkably successful one. Some of the largest financial institutions in this country and in London became subscribers to the issue.

The West Side Construction company made a contract with the Metropolitan Elevated under which it was to build the line and equip it ready for operation for $15,000,000 in bonds and $15,000,000 in common stock. After the sale of the $10,000,000 of bonds, on which there had been given a bonus of $2,500,000 of stock, there would remain for future distribution among the stockholders in the construction company $5,000,000 of bonds and $12,500,000 of common stock.

Work on the road was begun shortly after this, and not only was the money thus provided used, but further calls were made upon stockholders in the construction



WIRE REEL AND METER.

company. In May, 1895, the authorized capital of the construction company was increased from $3,000,000 to $6,000,000.

The Metropolitan was built regardless of expense. Throughout almost the entire distance the road runs on its own purchased right of way, and in laying out the line the engineers did not swerve for apartment buildings or for any other class of improvement. Nearly $5,000,000 was spent on right of way.

Patent Granted for a Chemical Element.

The *Electrical Review* of London finds that in France Professor Barriere has patented a new element. "We should think," it says, "this is the first time in the history of the patent offices of the world that anyone has come forward with a patent element. Even our own patent office, which gives such fatherly attention to the *perpetuum mobile*, and similar wild impossibilities, has probably never been called upon to grant a patent for a new element. We are sure, however, from what we know of our own patent office, that it will do so with alacrity when the occasion arises. They manage these things differently in Germany and in America. A recent issue of the *Chemical News* devotes a page or so to a report on the complete specification describing the new patented element, which has been named by Barriere 'lucium.' It is quite impossible, however, to gather from this specification any information of value concerning the properties of the new element, except that it is going to be used in connection with incandescent gas lighting, and will, of course, effect the usual revolution."

Wire Reel and Meter.

The accompanying cut gives a fair idea of a new wire-measuring and reeling device, manufactured by the Minneapolis Electric & Construction company, 13 South Fourth street, Minneapolis, Minn. One must see this machine, however, and its work to fully realize its usefulness. It will save time and money, and a short use will demonstrate its great value. In the meter the wire passes between two self-adjusting rollers, which admit of a wide range and will measure accurately either large or small wire. The pointers are movable and readily adjusted to the zero point.

A meter for counter use is also made. This is mounted on a neat base, to be used on a counter where a reel is not needed. For wire factories and dynamo builders the meter alone is valuable. The company's cable meter is made to order only, and is applicable for measuring cables of all sizes, rope or steel cables.

Whitman & Couch's New Telephone.

In the accompanying illustration is shown a new telephone, which is known as No. 93, manufactured by Whitman & Couch of 196 Summer street, Boston, Mass. It is provided with a quartered oak or black walnut backboard and battery box. The battery box is hinged, and has an iron shelf inside for sustaining the battery. The length of backboard is 24 inches. The manufacturers furnish special lengths, where it is desired, on short notice. This instrument is mounted with the Swedish coal grain microphone, a 10,000 ohm ringer automatic switch, standard long handle receiver and adjustable bells, and is suitable for lines one mile or 300 miles in length, and several can be worked on the same circuit with excellent results. One cell of battery is all that is required at each telephone.

Electricity in the Government Printing Office.

[*Continued from page 61.*]

generated under the most favorable circumstances, thus reducing its cost to a minimum. The building would be supplied with current for lighting or power at all times of the day or night every day in the year.

Owing to the addition to the office of the new west wing, new boiler house and machine shop, together with large extension of power transmission, the large switchboard recently installed is overcrowded and at least two more panels should be added to give proper control of our present electric plant. When this switchboard was designed we provided amply, as we then thought, for the future. One and a half panels or six main circuits were considered all that would be needed for some time to come, but the demand for light and power has been so great that we are now forced to connect circuits direct to the bus-bars without switches, as they should be, thereby allowing the attendant in dynamo room to be able to control all circuits leading therefrom.

From January 1 to November 30, 1896, there was a saving of 3,877,300 cubic feet of gas over the corresponding months of 1895. The only increase in cost of production of light over our old system, when we were only supplying a limited portion of the office with electric lights, was the extra amount of coal burned, the help in the dynamo room and boiler house remaining the same.

During the year 1896 there was consumed 3,874.6 gross tons of coal; in 1895, 3,123.3 gross tons, and in 1894, 3,671 gross tons, or 751 tons more in 1896 than in 1895, and 203 tons more in 1896 than in 1894. During the years 1894 and 1896 there was a long session of Congress and in 1895 a short one. Thus 1894 and 1896 are on about as equal a basis as is possible to obtain to draw comparisons from. The difference during these years was 203 gross tons of coal in favor of 1894. With coal at $4.62 per gross ton, price of present yearly contract, this would amount to $937.86, while the saving in gas at $1 per 1,000 feet, for the entire year, would amount to $4,200, or a net gain of nearly $3,300 in the matter of lighting alone. This does not take into consideration the increase in electrical power supplied to the building in driving machinery which has lately been installed, which in itself would have more than consumed the coal difference if supplied under the old system of belts and shafting.

The cost of production of electrical output for the month of October was 3½ cents per kilowatt-hour, which includes cost of help in dynamo and engine room, boiler

house, also coal, oil, waste and necessary incidentals. This very low cost of power shows for itself how economically our present electric plant is being operated.

The cost for maintenance and necessary repairs of the lighting and power branches of our plant will be very small indeed if the present indications can be taken for a criterion from which to make conservative estimates.

Convention Attendance.

ON CHICAGO CONVENTION TRAIN.

Abadie, E. H.
Austin, M. B.
Barrett, J. P.
Collins Carroll.
Cutter, Geo.
Donley, W. E.
Floy, Henry.
Garrison, A. C.
Gray, W. H.
Gregory, Chas. E.
Grissom, W. H.
Harding, J. H.
Hill, Jos. M.
Korst, P. H.
Kuehmsted, A. Louis.
Lane, T. S.
Low, Willard W.
Luther, Fred. P.
Maurer, J. S.
McDougall, D. G.
Perry, Frank L.
Roe, Juliao.
Schott, W. H.
Searlog, Geo. S.
Smith, Wm. M.
Stine, Prof. W. M.
Terry, Franklin S.
Thayer, Geo. Langstaff.
Wheaton, M. C.
Whyte, Geo. S.
Williams, J. P.
Wolff, James.
Wormley, J. C.

OTHER MEMBERS AND VISITORS.

Bean, W. Worth.....St. Joseph, Mich.
Bradshaw, J .....Milwaukee, Wis.
Bragg, W. P.....Monroe, Wis.
Boggis, H. F.....Milwaukee, Wis.
Brittan, L.....Waukegan, Ill.
Browne, F. A.....Marinette, Wis.
Bunce, A. C .....Milwaukee, Wis.
Buckley, W. J.....Chicago
Burch, Loren W. .....Madison, Wis.
Burt, M. A.....Baraboo, Wis.
Case, J. I.....Racine, Wis.
Child, John.....Chicago
Christie, S. E.....Chicago
Church, J. V. S .....Chicago.
Church, Wm. L.....Milwaukee, Wis.
Cloos, Jacob.....Milwaukee, Wis.
Cole, G. L.....Beloit, Wis.
Coleman, S. G .....Milwaukee, Wis.
Collins, C.....Elkhart, Ind.
Colman, E .....Fond du Lac, Wis.
Copeland, F. A.....La Crosse, Wis.
Crawford, W. H .....Milwaukee, Wis.
Crider, J. C.....Pittsburg
Daniell, E .....Menominee, Mich.
Davis, G.....Neenah, Wis.
Dee, Jas. R.....Houghton, Mich.
Debell, E. L .....Sheboygan, Wis.
DeWolff, D. C.....Chicago
Doherty, H. L.....Madison, Wis.
Earles, J.....Kaukauna, Wis.
Elliott, W. L .....Chicago
Farwell, G. A.....Waukesha, Wis.
Ferris, Thos.....Milwaukee, Wis.
Ferry, S. A.....Chicago
Gage, C. T.....Chicago
Goltz, W.....Milwaukee, Wis.
Grover, T. F.....Wauwatosa, Wis.
Hanley, G. W .....Marinette, Wis.
Harrison, Geo. W .....Ashland, Wis.
Hay, C. E.....Springfield, Ill.
Higgins, H. C .....Marinette, Wis.
Holcomb, E.....Springfield, Ill.
Kellogg, F.....Spencer, Iowa
Kerns, L. E.....Madison, Wis.
Kittman, L. W.....Chicago
Kountz, R. F.....Neillsville, Wis.
Lord, I. P.....Waupaca, Wis.
Mahaney, W. D.....Chicago.
Mayfield, M. E .....Rockford, Ill
McCorkle, A. H.....Monmouth, Ill.
McGill, J. H.....Chicago
McKinlock, Walter C .....Chicago
McLaren, G. S .....Milwaukee, Wis.
McLeod, John D.....Milwaukee, Wis.
McMaster, F.....Chicago.
Mercein, T. R.....Milwaukee, Wis.
Mullen, E. G.....Milwaukee, Wis.
Ney, R. W.....Waukegan, Ill.
Norcross, Pliny.....Janesville, Wis.
Paige, C. C.....Oshkosh, Wis.
Pamperin, T. A.....Oconto, Wis.
Patitz, A. M.....Milwaukee
Pearce, H. F.....Negaunee, Mich.
Pierce, D. H .....Appleton, Wis.
Pierce, R. H.....Chicago
Randolph, R. J.....Milwaukee, Wis.
Rau, O. M.....Marquette, Mich.
Retallic, Chas.....Cleveland.
Rockwell, Chas. H.....
Rohm, Geo. F.....Manitowoc, Wis.
Schuette, John .....
Shaffer, W. C.....Elgin, Ill.
Shedd, H. E .....Milwaukee, Wis.
Smith, A .....Milwaukee, Wis.
Smith, W. C.....Cleveland, O.
Stevenson, M. L.....Richland Center, Wis.
Strang, A. J.....Chicago
Sullivan, W. H.....Chicago
Summers, L. L.....Chicago
Terry, A. S .....Beaver Dam, Wis.
Thorp, W. H.....Marshfield, Wis.
Upham, W. H .....Chicago
Upham, W. P.....South Milwaukee, Wis.
Williams, F. B .....Chicago
Wilkinson, W C.....Chicago
Wilson, W.....Marquette, Wis.
Willson, R. A.....

Ordinance for an Electric Street Railway in Wabash Avenue.

After a long and bitter contest between the General Electric Railway company, the Chicago City Railway company and a large number of property owners who are opposed to any street-car line on the street, the City Council of Chicago, on January 25th, by a vote of 46 to 16, passed an ordinance granting a 20-year franchise to the General Electric Railway company for a street railway on Wabash avenue from Twenty-second to Sixty-third street. The ordinance also gives consent for a large number of other lines on South Side streets, as published in the WESTERN ELECTRICIAN last week, but the Wabash avenue route is the principal one and the one on which the fight was made. The ordinance gives the company the right to operate the cars by any system or systems of underground cable or conduits, or underground electric power, and in unimproved streets the right to use any method of propulsion other than horse or steam power. The company is to pay the city $200 a mile per year for the last three years in the first period of five years; $300 per mile per year for the second period of five years; $400 for the third period, and $500 for the fourth.

It is also to be noted that at the same meeting of the council Mayor Swift vetoed Alderman Martin's order for for the appointment of a special committee of investigation in relation to street-car traffic. This order was printed in this journal last week. When it was passed, it was stated that it was presented to follow out a suggestion of the mayor, but in his veto the mayor said that the order was inconsistent and undignified and could not be carried into effect.

Progress of Electrical Engineering in Germany.

From an interesting article in the *Electro-Techniker*, by R. Lüders, it appears that in Germany within the last 12 months the supply of current to towns for lighting has increased about 20 per cent., as indicated by the number of lamps connected on to the central stations; a percentage increase which means about 150,000 lamps. The combination of lighting with electric traction seems to prove advantageous, and such installations have been pretty extensively carried out. The important reduction in price that follows from longer hours of consumption is illustrated by the tariff of an Upper Silesian installation, where the rate is 1.2 cents per hour up to 400 hours, and half a cent per hour thereafter. The driving of machine tools by the electric current has been considerably extended; the electric transmission of power on warships has also been very successful.

In the field of railway working a considerable advance has to be noted; the electric current has been used for shifting points at Berlin-Westend and Untertrückheim stations. According to the reports of the principal firms, the alternate current, and especially polyphase, is fast gaining ground on the continuous current. The latter has been employed in an electric railway at Lugano.

At Dresden five street railway lines are driven with an expenditure of 1,500 horse power; the Hanover light railways consume 1,500 horse power developed in two power stations, and the extended Budapest street railway consumes 650 horse power. The total length of completed electric railways in Germany is 523 miles, while 512 miles are in course of construction.

On the first of October last year there were in Germany (excluding Bavaria and Wurtemberg) 8,554 heavy current installations at work, 8,160 of which were devoted to lighting purposes, and supplied 1,852,000 incandescent lamps and 79,000 arc lamps; 111 installations were used for electrolytic processes and 618 for power transmission.

In the telegraph engineer's department of the imperial postoffice several scientific investigations have been carried out; for instance, experiments on the spread of strong currents through the ground, and their availability for telegraphy without wires; investigations to determine the best form and material for telegraph lightning conductors and their earth connections, and investigations to discover the best means of protecting telephone, etc., lines from disturbances from leakage in heavy current circuits. In telegraphs and telephones a notable advance is to be seen; at the date cited the network of conductors in the German Empire (including Bavaria and Wurtemburg) consisted of about 90,600 miles of line and 130,000 miles of conductor, against 87,500 miles of line and 98,500 miles conductor in the previous year. There are 21,271 telegraph offices, of which 8,591 are provided with telephones. Alarm signals can now be sent from 9,796 stations, whereas in the previous year the number of stations was only 8,441.

Special activity has been exhibited in the building of trunk lines for connecting the telephone installations of different towns. During last year 7,200 miles of conductor have been used for this purpose. There are at present in existence 484 city telephone exchanges and 125,810 telephones, for which on an average 1,720,000 connections are made per day. Berlin alone has 82,865 speaking places, for which the daily average number of connections is 450,000, a record which is as yet unsurpassed. The longest telephone line in Germany, between Berlin and Memel, is 600 miles in length.

In a recent interview Governor Pingree of Michigan said: "I expect that this winter's session of the Michigan Legislature will introduce many reforms and carry out old ones that have lagged. Prices are too high. I was down in Boston some time ago, and I called up my son in Detroit by 'phone. I talked for 12 minutes, so they told me, and it cost me $18. Talk about golden words! I was a silver-tongued orator at that time if one ever existed. We don't propose to pay any prices like that in Detroit. We gave the Harrison company a franchise to rival the Bell company, and in three months, when it will have been completed, a man can have a 'phone in his office for $40 a year and one in his residence for $25."

CORRESPONDENCE.

New York Notes.

NEW YORK, January 23.—Public hearings on the rapid transit plan adopted by the commissioners on January 14th are now in order, and it may be a year before any actual construction work is undertaken. The first hearing is set for next Thursday. In my last letter I outlined the plan now before the commissioners.

By a bold daylight robbery in Broadway on Monday the Metropolitan Street Railway company lost $5,600. George S. Wickham has been a trusted collector for the railroad company, and it has been his custom to drive to the different stables under the control of the company every weekday, collect the money turned in by conductors, and take it to the Pacific Bank on Broadway near Grand street, for deposit. He rides in an open wagon containing a strong money box, and his driver is Seneca L. Battey. As no money is collected for banking on Sunday, the Monday morning collections are the largest. Wickham and his driver appeared in the wagon in front of the Pacific Bank about 1 P. M. on Monday, and Battey jumped out and ran into the bank to say that Wickham was ready to deliver the railroad cash. An employe of the bank wheeled a small truck to the front door to receive the bags of nickels and silver coins, and Wickham got out of the wagon and unlocked his strong box. There were six bags of specie in the box and one bag of bills. The bills amounted to $5,600. Wickham handed the bags of coin to Battey, two at a time, and Battey carried them into the bank. It was the intention of the collector to carry the bag of bills in last, as he had done on other occasions, and he placed that bag on top of the box to have it ready. After he had handed the last two bags of specie to Battey he turned to pick up the bag of bills, and it was not there. While his back had been turned to the wagon a thief had crept up on the other side and got away with the bag. Wickham's shout called Battey back, and then both called policemen and hunted around in a vain effort to find the thief. They managed to collect a crowd, but the thief who had stolen the money could not be found. Officers of the company say that they have the fullest confidence in the honesty of Wickham and Battey. The police say there is small hope of recovering any of the stolen money.

By an error in my letter of last week the figures of the annual statement of the Edison Electric Illuminating company of Brooklyn were made to do duty for the Edison company of this city. Of course the operations and earnings of the New York company are on a much larger scale.

The National Underground Cable company of New York has filed with the secretary of state, at Albany, a certificate of increase of its capital stock from $200,000 to $500,000. The company has a paid-in capital stock of $200,000 and debts and liabilities of $21,233. The certificate is signed by Edward S. Perot, chairman, and James P. McQuade, secretary, of the meeting of stockholders.

M. S.

Milwaukee, Wis.

MILWAUKEE, January 23.—A row, almost a riot in fact, which was only stopped by an order issued by the Supreme Court of the state—the order being borne to the scene of action by a special train—occurred early last week, when the Milwaukee, Racine & Kenosha Electric Railway company attempted to build a track over the Chicago & Northwestern railroad crossing at South Milwaukee. Judge Johnson of the Circuit Court had upheld the right of the electric railway company to build the crossing, and, after the Northwestern company had taken an appeal to the Supreme Court, he had refused to continue the temporary injunction restraining the electric railway company from beginning the work. The latter at once started to build the crossing. Bright and early in the morning there appeared upon the scene about 40 men, and they at once began throwing up dirt preparatory to laying tracks across the Northwestern road. About 80 men employed by the Northwestern railroad were also on hand, and so was that company's assistant superintendent with a locomotive. The locomotive ran back and forth over the crossing, discharging steam at the electric railway men, while laborers constantly threw back the dirt which the other gang shoveled off. This sort of thing, especially the discharge of steam, irritated the electric railroad men, and they began throwing stones and sticks at the engineer and his crowd. The village officials took sides with the electric railroad men, a number of whom were arrested. Toward noon there

was served upon the Northwestern Railroad company's men an order issued by Judge Johnson restraining them from interfering with the electric railroad employes, and the latter, thinking that they had won the day, proceeded to work again. But some time before they had finished a special train arrived from Madison, and an officer jumped off and served upon the electric railroad people an order issued by the Supreme Court commanding them to stop work upon the crossing until the whole matter could be heard in the Supreme Court. This means a delay of several months, in all probability. The Northwestern people say that the reason that they attempted to stop work on the crossing was that Judge Johnson had ordered the electric railroad people to consult General Manager Whitman of the Northwestern railroad in regard to the kind of crossing to be put in at South Milwaukee, and that they had disregarded this order of the court and had started work on the crossing without saying a word to Mr. Whitman.

The Supreme Court of the state has rendered an important decision on the subject of street railway franchises. The Milwaukee Electric Railway & Lighting company, by reason of its acquisition of the West Side Railway company, came into possession of a franchise to lay tracks on Twenty-seventh street, between Wells and State streets, a distance of only two blocks. The track had seldom been used, and after it had changed owners it was abandoned. When the street was paved with cedar blocks the tracks were torn up, the company not feeling sufficient interest in the matter to pay for the part of the new pavement between its tracks. The poles and wires, however, remained intact. When the Milwaukee & Waukesha Electric Railway company began figuring upon building lines in the city, and the council began to repeal unused franchises in order to provide a right of way for the new company, the Milwaukee company suddenly went to work one Sunday morning and began laying tracks upon the street. Residents got out an injunction as quickly as possible and stopped the work. The city afterward took up the tracks. The Supreme Court has now decided that the company had a right to lay tracks on the street, although it had given up the use of the right of way for a time. It was held that the taking up of the track for two years was not an abandonment of the franchise. When a street railway company accepts a franchise, it assumes the public duty to build the line and to operate it. This public duty cannot be repudiated. The state can compel it to perform that duty unless it is released in some legal way. The decision of the Supreme Court makes it incumbent upon the city to pay the cost of tearing up the tracks laid by the company and the cost of putting down the tracks again. The decision caused no end of surprise in the city. It is regarded as a ruling of very general importance.

The street railway people won another victory in the Supreme Court. The law provides that the street railway company shall pay into the city treasury a certain percentage of its gross income in lieu of all taxes, but the city officials, who are bent upon taxing the street railway in every possible way, charged some assessments for special work against its property. The property taxed was old street car barns virtually abandoned except for the storing of old cars and similar rubbish. The amount in dispute was only about $1,200, but the principle involved was deemed important on both sides. The company began suit to prevent the sale of its property for taxes. In the Circuit Court Judge Johnson held that only such property as was actually used for street railway purposes was exempt from ordinary taxation, but the Supreme Court reversed his decision, holding that the street railway company is exempt from all taxation except the payment of a percentage of its earnings. The decision applies to all the street railway companies in the state. C.

Northwestern Notations.

MINNEAPOLIS, January 23.—The Menominee River Boom company of Marinette, Wis., has engaged Engineer C. B. Pride of Appleton, Wis., to survey Chappe rapids, and if it proves that there is a 12-foot head there, a large dam will be built and the power conveyed to Marinette and Menominee by electricity.

Easterners are negotiating for water power, right of way and terminals for an electric railway line between St. Cloud and Little Falls, Minn.

A. C. Burmeister will probably put in an electric lighting plant at Redwood Falls, Minn., securing power from his flour mill.

The promoters of the electric line from Oshkosh, Wis., to Omro affirm that the line will be built and hope to begin construction in the spring, although the required capital is not yet secured.

Paul Gardner has applied for an electric lighting franchise at Langdon, N. D.

Sinclair Mainland has become superintendent of the Gas & Electric Light company of Green Bay, Wis., succeeding John Scott.

The Watertown, S. D., electric light company contemplates improvements to its plant.

The Bower City Light & Power company's plant at Janesville, Wis., was sold by the receiver to M. G. Jeffris, who purchased it as a speculation, the price being $1,175. It consists principally of wires and poles.

The city clerk of Superior, Wis., is securing data from other cities on the charges made by electric lighting companies for incandescent service to consumers.

The council of Kaukauna, Wis., has created the office of city electrician, to have complete charge of all electric wiring done in the city. The chief of the fire department has been appointed to the office.

The City Council of Tacoma, Wash., is considering the matter of overhauling the city electric light plant and putting in improved equipment.

It is rumored in Seattle, Wash., that the Port Washington street railway lines will adopt the convertible cars with movable sides capable of being changed into open or closed cars at short notice—such as have been introduced in Concord, N. H., as recently illustrated in the WESTERN ELECTRICIAN.

County Surveyor Abbott of Minneapolis suggests wiring the local jail, from which three prisoners recently escaped, so that any attempt at cutting a bar, opening the door, or anything of the kind would result in electrical warning to the A. D. T. office and guards instantly. C.

PERSONAL.

W. T. Osborn, one of the oldest electrical men in the West, was a recent Chicago visitor.

M. E. Baird of the Eddy Electric Manufacturing company, Windsor, Conn., was in Chicago last week.

A. F. Espersen, vice-president and manager of the Pacific Electric company, La Crosse, Wis., is in Chicago this week in the interests of the Pacific shade lamps and other electrical specialties.

President Thomas C. Mendenhall of the Worcester (Mass.) Polytechnic Institute is mentioned as a possible successor of the late General Francis A. Walker as president of the Massachusetts Institute of Technology.

Professor G. Ferraris of Turin has been elected president of the Italian Institution of Electrical Engineers which has just been formed at Milan. Professors G. Mengarini of Rome and G. Colombo of Milan are vice-presidents.

E. Ward Wilkins of the Patrick & Carter company, the well-known manufacturer of electrical house goods and general supplies, has started on an extensive western trip, stopping at many of the principal cities between Chicago and San Francisco.

Mrs. John Kruesi of Schenectady, wife of the well-known mechanical engineer of the General Electric company, died at noon on January 19th, after a long illness. Mrs. Kruesi was a woman of beautiful character and was highly esteemed. In their bereavement the husband and children have the sincere sympathy of a wide circle of friends.

A service in memory of Du Bois Reymond is planned in Berlin similar to the services recently held for Treitschke and Curtius. It is also proposed to erect a monument to him in the garden in front of the university, side by side with those to Helmholtz and Treitschke. Du Bois Reymond spent the last 50 years of his life in the service of the university.

Clarence E. Stump, who is very well known in electrical and street railway circles, is now president and treasurer of the company publishing *City Government*, a monthly magazine for city officials, taxpayers and others interested in municipal affairs. The office is in New York, and a periodical of undoubted interest and value is issued therefrom. Mr. Stump has a wide acquaintance, and his experience and talent will be of great assistance to the journal with which he is now connected.

Jacob Brett, who, with his brother, John Watkins Brett, laid the first submarine cable between England and France, in 1850, died in London on January 9th in his eighty-ninth year. The Brett brothers were pioneers in submarine telegraphy, Jacob Brett taking out his first patent in 1845. In 1854 they laid a cable across the Mediterranean, from Algiers to Corsica; two years later the first Atlantic telegraph company was formed, and the first cable successfully laid in 1858 by Sir Charles Bright, though it failed electrically after its submergence. J. W. Brett was greatly responsible for the formation of this company, and subscribed £25,000, which was ultimately lost. He died in 1865, shortly before the ultimate realization of the commercial working of the Atlantic cable. He left the bulk of his fortune to Jacob, who for a time lived in affluent circumstances in Paris, whence he fled at the outbreak of the revolution. He settled in London, but his own unselfishness, legal suits, and, it is said, lack of business qualifications, deprived him of his ample fortune, and at the time of his death he was dependent on a civil service pension of £100, given to him in 1886 by Mr. Gladstone

Sir Henry Mance, the new president of the British Institution of Electrical Engineers, comes from a Devonshire family. He was born at Exeter in 1840 and was educated at Bath. He entered the Electric & International Telegraph company, where he remained until 1863, when he was appointed by the secretary of state for India to the Government Persian Gulf Telegraph Department. Although only 24 years of age, he was rapidly promoted to the rank of superintendent, and for some years served in that capacity in Mesopotamia, Persia, Arabia, Beloochistan and India. He acted as traffic manager for one or two years, and was subsequently appointed engineer and electrician, which position he filled until his retirement. His last official act in 1885 was to renew the cable which he helped to lay in 1864. His official report of the expedition gives much useful information. He has contributed several valuable papers to the technical journals, and is the author of the well-known "Mance's Methods," the first being for ascertaining the internal resistance of a battery, the second for eliminating the effects of polarization and earth currents when testing faults in submarine cables Since his retirement from government service he has become interested in telegraph companies. He is also chairman of the Oxford Electric Light company. He is a companion of the Indian Empire, and received his knighthood in 1885 in recognition of important services in connection with his invention, the heliograph. The Spaniards were the first to adopt this method of signaling. He has been a member of council of the Institution of Electrical Engineers for some years, and vice-president since 1893.

ELECTRIC LIGHTING.

I. S. Moe, proprietor of the Valley steam saw and flouring mills of Moeville, Wis., is about to put in an electric light plant, and requests correspondence with manufacturers and others who can supply his need.

The Brush Electric Light & Power company of Columbus, Ga., intends to enlarge its water power development to about 2,000 horse power from 1,200 horse power and will be enabled to furnish electric power to small industries.

The electric lighting of the city of San Luis Potosi, Mexico, has passed into the hands of Americans. The San Luis Potosi Electric company was recently chartered under the laws of West Virginia, with C. H. White of New York city, president; J. D. White, secretary, and George A. Waddill of San Luis Potosi, manager. The company has a capital of $100,000. The General Electric company will put up the plant, which will be of sufficient power to operate 5,000 16 candle power incandescent and 250 1,200 candle power arc lights.

An ordinance has been introduced in the Chicago City Council to allow the Garfield Electric Light & Power company the right to lay wires underground and to erect power houses in the Twelfth ward for the purpose of furnishing light, heat and power to the residents of that ward. It provides that the prices to be charged by the company shall not exceed three-fourths of a cent an hour for each 16 candle power incandescent lamp, or 35 cents a night for each 1,600 candle power arc lamp, and not more than 40 cents per horse power hour for all power furnished to private consumers. The company agrees to pay after the first five years three per cent. of its gross receipts to the city as compensation. The franchise is asked for 25 years. The order was referred to the committee on gas, oil and electric light.

The *Chicago Daily News* of January 22d tells "the news of an important deal consummated in San Francisco. The Edison and the San Francisco Gas Light company have consolidated, after having waged bitter war on each other. The capital stock of the new organization will be $20,000,000, of which $10,000,000 will be issued to the stockholders of the San Francisco Gas Light company; $2,750,000 to be issued to the stockholders of the Edison company, and $1,066,666.66⅔ to be placed in trust in the hands of a trustee selected by the directors of the new company, which said stock is to be placed in escrow for the purpose of redeeming the outstanding bonds of the Edison company. All the remainder of the stock is to be held in the hands of the company and will not be issued unless necessity requires the same for the enlargement, extension or improvement of the plant."

It may serve to illustrate the ability of the electric light to hold its own against any other form of illuminant, says a writer in the *Canadian Electrical News*, if I repeat a little story which a friend of mine related to me the other day. "I had occasion," said he, "to visit recently a little German village in Western Ontario, and was surprised to find the streets and business places lighted by incandescent lights. In the hotel where I put up there were 12 lights. Curious to know what profit was being made by the owner of the lighting plant I inquired of the hotel man, how much his lights cost him. "Shust von cent each for efery nighd," was the reply. "Do you mean to tell me," said I, "that you pay only about 70 cents per week for 12 incandescent lights." "That's shust aboud id," said he, and added, "it ust to cost me 20 cents a night ven I burnd lamps." "Well," said I, "I guess the owner of the lighting plant doesn't make anything out of the business." "Doesn't he?" replied the hotel man, with a sarcastic smile, "he gets his mill lighted for nodtings!" It will doubtless be

comforting to the hearts of owners of electric lighting plants to know that in one instance at least the modern illuminant has been able to distance all competitors, but municipal corporations and others will do well to beware of drawing from this incident the inference that there are heaps of money to be made in the electric lighting business.

The *Hartford Daily Times* of January 9th devotes a page to a description of the new plant of the Hartford (Conn.) Electric Light company, which has installed at its State street station the biggest storage battery plant in the United States at a cost for the battery alone of nearly $100,000. The description is not technical, and the article concludes as follows: "Any account of Hartford's electric light system would be incomplete which did not include a record of the fact that it is chiefly the work of one man, Austin C. Dunham, who has so long been identified with some of the greatest manufacturing interests of Connecticut. Mr. Dunham's principal assistants have been and are R. W. Rollins, superintendent of the company's works, and Professor William Lispenard Robb of Trinity College, who is the company's electrical expert. These gentleman have all had a very busy year, while the great changes described in this article have been going on. They have the satisfaction now of being able to show one of the best organized, best equipped and most successful electric companies in the world. The capital of the Hartford Electric Light company is $350,000. Not all of it has yet been issued, in spite of the great investment of capital during the past year. There is no 'water' in this stock. The company is in a splendid position for future development. It has been able heretofore to supply light and power more cheaply than most other American companies. The City Council has recently declared through a committee, that there is no justification for any investment by the city of Hartford in a municipal electric plant. The electric system of Hartford is something for its citizens to be proud of, and when they become aware of the extent and uniqueness of it they will not fail to award proper credit to the gentlemen who have so quietly and sucesssfully built it up, and made it the model electric plant of the country."

ELECTRIC RAILWAYS.

The annual meeting of the stockholders of the Rochester Railway company was held January 19th. The following-named directors for the ensuing year were elected: H. Sellers McKee, Pittsburg, Horace Magee, Philadelphia; Thomas De Witt Cuyler, Philadelphia; Benjamin Graham, New York; John N. Beckley, Frederick Cook, E. M. Upton, George W. Archer, Jacob Gerling, Erickson Perkins, F. P. Allen, Eugene H. Satterlee and Harold P. Brewster, Rochester.

On application of the Stirling company of Chicago, the Belle City Electric Street Railway company of Racine, Wis., was placed in the hands of a receiver on January 16th by Judge Fish of the Circuit Court. H. J. Smith of Racine was appointed receiver and gave bonds of $25,000. Recently the Stirling company secured a judgment against the Belle City company for $3,000 in the United States court. It pressed the claim for payment, and, being unsuccessful, appealed to the Circuit Court, at the same time bringing suit for the amount. Judge Fish promptly declared the railroad company insolvent. The road is owned mainly by Jackson I. Case and is said to have cost $450,000. There is a bonded indebtedness of $300,000, of which $100,000 is held by Mr. Case and the heirs of the late Jerome I. Case; $50,000 by Charles H. Hathaway of Cleveland, Ohio, and $50,000 by A. J. McNair of St. Louis. Interest on the bonds was due January 1st, but has not been paid. On account of the prevailing hard times the company was unable to meet its obligations.

The Japanese are not only extending their roads and railways for ordinary business purposes, but seem determined to utilize the resources of science for pleasure and health. One of the most favorite districts in the neighborhood of Yokohama is that around Hakone and Miyanoshita, about 40 miles distant, and at an elevation of fully 2,000 feet above the level of the sea. A steam railway goes within a comparatively short distance of Hakone, but now an electric railway is being built between that and Miyanoshita and some of the neighboring stations. It is said that the promoters are meeting with considerable difficulty, as the population thereabouts—the coolies, jinriksha-pullers and kago bearers—see in the railway a menace to their already more than scanty income. It is, however, expected that the work will be completed before May, when the summer visitors begin to flock to the district. The trolleys are to run from Kozu, following the older horse tramway to Odawara and Yumoto, thence to Miyanoshita. As there could scarcely be a more unpleasant road in places than that between Miyanoshita and Yumoto, the company should make a success out of the undertaking, even if it only charge one-half the rates by the present methods.

POWER TRANSMISSION.

The sawmill of the American River Land & Lumber company, which is located close to the power house at Folsom, Cal., of the Folsom-Sacramento power transmission plant, was started successfully on the 1st of December, cutting 50,000 feet of lumber per day. The current is three-phase, taken from the power house at Folsom, and the motors are all of the induction type, the installation having been made by the General Electric company. The motors employed are one of 75 horse power, one of 50 horse power, both running at 720 volts, three of 30 horse power, and one of five horse power operating at 200 volts.

To the WESTERN ELECTRICIAN of January 9th was announced the awarding of the contract for the electrical utilization of the Falls of St. Anthony at Minneapolis. Further details are furnished by the General Electric company: The water will pass through turbines of Stillwell-Bierce & Smith-Vaile manufacture, seven of which, each of 1,000 horse power capacity, will form the initial hydraulic equipment. The electrical equipment will consist of a plant comprising both direct current railway apparatus for the needs of Minneapolis and three-phase apparatus for transmission of part of the power to St. Paul, 10 miles distant. The direct current portion consists of two 700 kilowatt General Electric multipolar generators, with a speed of 130 revolutions per minute, furnishing current at 600 volts, and two 100 kilowatt exciters for the three-phase alternators. The three-phase generating plant consists of five 700 kilowatt alternators with a frequency of 35 cycles and an initial voltage of 3,450 volts. This pressure will be raised to 12,000 volts in six step-up transformers of the air-blast type, and at this voltage the current will go to St. Paul either by overhead or underground wires. This has not yet been settled. At St. Paul the pressure will be reduced in 15 step-down transformers, when the current will be led into the rotary converters of special type. Of these there will be five. They will resemble in appearance those which the General Electric company has installed in the power house of the Buffalo Street Railway company, to take care of the power transmitted from Niagara Falls. They are eight-pole machines, each of 600 kilowatts capacity, running at 520 revolutions and turning out direct current at 580 volts. They are designed to operate in parallel with each other, or with the generators now driven by steam in the existing station. The water power development and the electric plant completed by the Pillsbury-Washburn company will be operated by the Twin City Rapid Transit company, a lease having been made between the two companies to that effect. The street car company will send to St. Paul about 3,000 horse power, leaving 4,000 horse power to be used at Minneapolis. When the new power is set to work running the street cars the street railway company will dismantle the Thirty-first street power station, using the room for other purposes. It will continue the main power station at Third avenue North and Second street and also the power station in St. Paul. These will be kept ready for emergencies, such as a breakdown, a sudden call for extra power and similar occasions. In case there is water enough and conditions are favorable there are still three more units to be installed at the dam.

MISCELLANEOUS.

The Electric Light is in trouble. A bad leak was discovered recently and pumping had to be resorted to. The Electric Light is a brig, and on putting out from New York recently it was discovered that recent storms had strained her seams so badly that she had to turn about for port at Sandy Hook. She has the sympathy of the fraternity.

A London paper says that one afternoon a gorgeous motor car, used by a firm for advertising purposes, decked with a driver and a footman in gold-laced uniforms, was speeding along Stoke Newington road, when the machinery suddenly gave a sharp crack and broke down. The liveried attendants were obliged to descend from the vehicle and push it slowly along from behind. A number of cabmen in the neighborhood promptly entered into the humor of the situation and formed themselves into a procession, one of them performing an imitation of a dead march on an old trumpet which he had picked up somewhere.

These statistics are given in the English *Electrical Review:* In Paris there are at present seven electric lighting undertakings, of which one is under municipal control. In London there are 13, of which three are the property of the parish authorities. In Paris the average selling price of the kilowatt hour is about 11½d.; in London it is about half that price. In October last year the number of lamps connected up in Paris was 545,914 (including 7,448 arc lamps); in London, at the end of the previous year, 1,178,000. In Paris, besides electric lamps, there are 220 electrically driven elevators, and the total energy supplied to motors is nearly 2 000 horse power. The consumption of electric energy in 1895 was: In Paris 8,107,253 kilowatt-hours; in London, exclusive of the city, about 9,553,105 units. In Berlin there are, on the network of the Berliner Electricitätswerke alone, 166,192 incandescent lamps, 8,216 arc lamps, 1,347 motors developing 4,813 horse power, and 292 other appliances. The consumption of energy amounted to 9,770,800 kilowatt-hours, and the dividend of the company to 13 per cent.

TRADE NEWS.

The Ball & Wood company will remove its New York offices on February 1st to the Beard building, 120 Liberty street.

The Brooks-Follis Electric company of San Francisco will hereafter supply the Coast trade with the well-known dynamo brushes manufactured by Charles Wirt of Philadelphia.

An interesting photograph decorates the Dayton Globe Iron Works company's '97 calendar. It is of "the largest horizontal turbine outfit ever constructed," built for the Boston & Montana Consolidated Copper & Silver Mining company of Great Falls, Mont. A pair of 57 inch New American wheels, mounted horizontally on a 10 inch shaft to develop 3,945 horse power under 50 feet head, is shown.

Owing to increase of business the Phœnix Interior Telephone company of New York has been obliged to remove to larger quarters. It has leased the five-story building at 93 Washington street, where it is now in position to meet the needs of its customers.

The Electric Appliance company's combined calendar and moonlight schedule is very well gotten up and should be useful to those in charge of street lighting plants, although the latitude for which the calculations are made is not stated. The advertising matter is attractively displayed.

One of the most useful souvenirs recently received at this office is a neat little pin-cushion from the Huebel & Manger company of Brooklyn. To everyone who may be favored with one of these useful articles it should certainly be a constant reminder that Huebel & Manger bells and push-buttons "fill the bill" satisfactorily.

The book of Green's economizer seems to show that the cover legend (plus on steam and minus on fuel) is correct. The book is evidently prepared with great care and thoroughness and gives a great deal of information valuable to steam users. It is a very creditable work and should be added to the list of trade catalogues that are really a help. The Chicago office of the Fuel Economizer company is at 1540 Marquette building.

The D. A. Kusel Telephone Manufacturing company of 1105 Pine street, St. Louis, has just closed a contract for a complete exchange equipment at Malden, Mo., where several county lines will connect with the county lines from Dexter, Mo., where the D. A. Kusel instruments are also used. Eight of this company's telephones have been recently sold to a canal company in California and are used in circuit along the entire distance of the canal.

The Advance Electric company of Indianapolis, Ind., sends the following: "The Advance Electric company is the recent successor of the late firm of MacCurdy & Smith. It is situated in their old stand, 94 and 96 North Meridian street, Indianapolis, Ind., and is an incorporated stock company. The officers are D. D. Smith, president; Harry B. Marsh, secretary and engineer; Charles H. Talmage, treasurer. This company has just put in a select stock of new goods and is prepared to do a wholesale, retail and construction business. Mr. Smith of the late firm has been retained in the management of the new."

Advertising in street cars has grown to large proportions, the principal patrons being dealers in articles purchased by women. Several companies are engaged in this class of work, and among them is the Railway Advertising company of 261 Broadway, New York, which has exclusive privileges on lines in that city and other eastern towns. The company has issued a "Book of Transfers" on the Metropolitan company's lines in New York, with a valuable map, which ought to be useful to New Yorkers. Edward Caldwell, an experienced and capable newspaper man, pleasantly remembered in Chicago, is manager of the company.

S. K. Reynolds, agent, room 626, 136 Liberty street, New York, reports a very satisfactory business. The "self-insulating" cut-out or "perfect bug" put on the market by Mr. Reynolds is meeting with success; thousands of them are now being ordered and placed with fixture and supply houses throughout the country, and they are highly recommended by consulting engineers and others. The "bug" is said to be smaller than any other on the market. Insulation is effected with the connection; therefore it requires no cover, it cannot ground the fixture, and tape is unnecessary. It is claimed to be the cheapest device of its kind on the market.

The arrangement and data in the General Electric company's new catalogue and price-list of railway apparatus and supplies make it valuable to engineers and railway companies. The useful principle of interchangeable parts is carried down to the minutest detail, and catalogue numbers are given for nearly all parts, so that the smallest bolt or nut may be ordered separately. Cuts clearly indicate the right number of a part, where it is necessary to supplement the text of the list; and the whole is well printed on pages of convenient size, supplied with an index to subjects and an index to numbers and bound in flexible cloth covers. Although a trade catalogue, this little book will be of great value to anyone interested in electric railways.

An order was recently secured by the Wagner Electric Manufacturing company of St. Louis, aggregating over 7,000 lights capacity in standard transformers; the requirement of the sale was immediate delivery. The company received the order over the long-distance telephone located in its office at 5 P. M. on January 13th. For transporting this order one of the largest cars was required, with an ability to carry thirty-odd thousand pounds. By 10 o'clock on the 14th of January the car was loaded. It left that evening at four o'clock for Chicago and was delivered the following morning at seven o'clock. The following is a copy of a part of a letter from the purchaser: "You are certainly to be congratulated upon the promptness in filling and shipping the order, and it occurs to us that the ability of a manufacturing company to so promptly respond to urgent requests for so large transformer capacity is a good argument for the use of their make of transformers. We do not understand that any other one manufacturer was prepared to accept the order and guarantee delivery within the time required." The Wagner company's ability to make prompt shipment has resulted in a great deal of business, and it is certainly a valuable characteristic.

BUSINESS.

The Cloobrock Steam Boiler company of Brooklyn, N. Y., has just issued a handsome catalogue, a copy of which will be sent upon application.

From the far East comes a contribution to the season's calendars by Bagnall & Hilles of Yokohama and Singapore, electrical engineers, dealers and contractors. It is mounted on rollers and is of Japanese design.

George F. Virtue, who has been general manager of the Consolidated Tube company of Boston, Mass., has taken charge of the conduit department of the Clifton Manufacturing company of 65 Franklin street, Boston, Mass. He states that this company's product possesses many points of merit.

The new catalogue, No. 5, issued by the Anchor Electric company of 71 Federal street, Boston, contains as usual valuable information for the users of electrical supplies, showing the valuable features of this company's switches and other apparatus. The Anchor socket is emphasized strongly in this catalogue.

The People's Electric company of Madison, Wis., have established two new plants and has now, it is stated, nearly every central station in its territory on its books. Preparations are being made for more extensive operations, and the business of the coming year is expected to be four-fold. Several new agencies have been obtained, and the general business outlook for more is very gratifying to General Manager Burch.

President Edward H. Phipps of the Connecticut Pipe Manufacturing company of New Haven reports that he is looking for a season of great activity in his line of business, and is preparing to meet the conditions by the manufacture of a large stock. The product of this company is well known East and West, as it has many miles of pipe laid for water works and subways for electric wires. The Phipps patent underground pipes are a specialty strongly identified with the electrical business.

The call for various shapes in opal, clear, rough and colored glass globes and shades is keeping James J. Murray & Co. of Philadelphia unusually busy. Murray & Co. report that the electrical branch of their business has nearly doubled in sales during the last year, and that they are obliged to meet this increase in business by giving more room in their large factory to this department. The Murray flint glass globes and shades are well known for artistic effects. Prompt shipment is guaranteed.

The Metropolitan Electric company of Chicago has been given the general western agency for the Alcatraz electrical compound. This will interest all consumers of electrical compounds, and those not now using the Alcatraz will do well to give it a trial, as it has been proved more than satisfactory. It is claimed that it will not scale, crack or burn, adheres tenaciously, and is proof against the action of the elements. The compound is made from the Alcatraz asphalt, and possesses many points of superiority.

The 100 and 150 hour direct current constant potential arc lamp is rapidly securing control of this particular field of arc lighting. The Electric Appliance company, as general western agent for the Upton arc lamp, is glad to report that it will soon be prepared to supply its customers with a long-burning Upton arc lamp, which has features not possessed by any other lamp on the market, the particular one being the entire absence of feeding or regulating mechanism. The experimental lamps turned out up to date have given good results.

The Interior Conduit & Insulation company of New York reports large orders for its new standard iron-armored conduit, and that it is running nights in order to fill orders. The company has completed arrangements whereby this department of its works will be enabled to work overtime for a long time. The fact that this conduit is extremely light and that it has exceptionally small outside diameter for a given inside diameter is a feature which seems to be appreciated by the trade. The joints of this conduit are thoroughly tested.

The "O K" dry battery manufactured by the Non-polarizing Dry Battery company, 347 West Broadway, New York, with western office at 95 Hartford building, Chicago, under the management of J. L. Bowles, is, it is claimed, destined to become the leading dry battery on the market. In construction it is radically different from any other dry cell in use, and the insulation is said to be as perfect as it is possible to make it. The main effectiveness and utility of this cell lie in the fact that it consumes none of its power when inactive, as it has no local action whatever; there is nothing in it that will polarize; therefore it will not degenerate while idle and will show the same strength no matter how long it may be kept unused. Every cell is thoroughly tested before it leaves the factory. This battery is noted for its quick recuperation and speedy recovery. The current strength of this cell diminishes more slowly on short-circuits, it is claimed, than other makes of this type, and it is said that temperature has no effect on this cell whatever. This battery is made in four sizes, each having an electromotive force of 1.5 volts. Type B, cylindrical, 3 by 7 inches, giving 7½ to 10 amperes, internal resistance .15 ohm, is intended mainly for the operation of railroad signals, telephones and gas engines, etc. Type C, cylindrical, 2¾ by 6 inches, giving 6 to 8 amperes, internal resistance .20 ohm, while intended mainly for general uses, such as gas lighting, fire and burglar alarms, annunciators, electric bells, etc., yet it is in use by railways on signal work and telephone companies in their general work. Type D, cylindrical, 1½ by 4½ inches, giving 3 to 5 amperes, internal resistance .30 ohm, is for use in medical batteries, testing outfits and general work where space and carrying capacity are limited. Type S is a square section, 2 by 2¾ by 7 inches, giving 6 to 8 amperes, internal resistance .20 ohm, and is especially adapted where close packing is essential. Reports of many tests could be given, but it is sufficient to say that this battery is now being used by a number of telephone companies in their general work in place of the wet battery formerly used, and by a number of prominent railroad companies for the operation of their signal systems and telephone service, which in itself is conclusive evidence of the excellence of this cell.

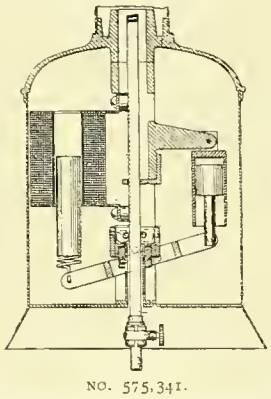
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued January 19, 1897.

575,322. Incandescent Lamp Socket. Reuben B. Benjamin, Chicago, Ill. Application filed March 16, 1896.

This socket has a tapering base, a recess in the end and lateral openings or recesses in the sides; contact terminals are provided in the base, the binding screws securing the terminals respectively in position, the upper shell or casing fitting upon the end of the base, and the lower tapering shell screwing into the end of the shell.

575,332. Electrically Illuminated Jugglery Apparatus. Morris Cronin, London, England. Application filed October 30, 1896.



NO. 575,341.

This apparatus consists of electric battery cells provided with expansible gas receptacles over their filling inlets; the cells are fixed to a foundation plate of ebonite or the like, having one or more electric lamps fixed thereto, and an outer inclosing sheet metal hollow frame is made in detachable parts, and within it the foundation plate is fixed, the frame having holes provided with colored transparent material, and with a switch for turning the light on or off.

575,341. Clutch for Arc Lamps. Eugene Fiskbeiner, Brooklyn, N. Y. Application filed July 27, 1896.

In a regulator for electric arc lamps there is the combination with a tube through which the carbon-holding rod is adapted to pass, of a pair of eccentrics journaled at the upper end of the tube, levers fulcrumed to the respective spindles of the eccentrics, and having slots in their outer ends, a device adapted to move vertically on the tube, and having projections passing through the slots of the levers, and a pivoted carriage supporting the projections.

575,346. Electric Railway. William Grunow, Jr., Bridgeport, Conn. Application filed October 28, 1895

An underground conduit for electric railways, comprising a metal trough having a flexible cover or top composed of flexible metal plates, each of which is secured to the sides of the trough and to the depressible rail, the plates being curved inwardly at their adjacent edges and securely bolted between strips of insulating material, between which is placed a depressible contact rail on a level with the surface of the track, the conduit being also provided with a conductor situated in the bottom of the conduit and in proximity to the contact rail.

575,354. Electric Rail Bond. William Jeas, Johnstown, Pa. Application filed June 30, 1896.

A portion of metal similar in nature to the metal of the bond-bar is integrally united to the rail and adapted to have the bond-bar attached thereto

575,366. Electrical Controller. William H. Morgan, Alliance, Ohio. Application filed September 4, 1895.

A main frame made in two parts and has a ventilating opening therein; an annular open frame is disposed between the parts of the main frame, and a series of resistance coils is supported on the annular frame.

575,392. Apparatus for Sewing Carpets. Philip Diehl, Elizabeth, and Edwin H. Bennett, Jr., Bayonne, N. J. Application filed March 3, 1892.

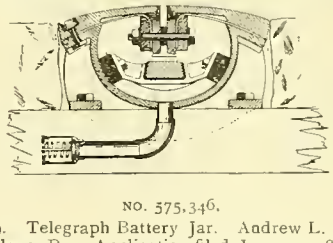
Means are provided for supporting long sections of fabrics edgewise vertically, and a traveling sewing machine is adapted to be fed along on the fabrics, and is provided with an electric motor operatively connected with the driving shaft of the machine; there are also a track or support parallel with the fabrics, a trolley or carriage traveling on the track or support, an elastic connection between the trolley or carriage and the traveling sewing machine, a conductor having suitable electrical connections with the motor, and a take-up device to control the slack of the conductor.

575,394. Magneto Telephone. Stephen D. Field, Stockbridge, Mass. Application filed August 11, 1896.

A differential inductance magneto-telephone having its magnet pole-piece or core associated with two oppositely wound or connected exciting or actuating coils connected in parallel with each other, one of the coils being formed of a relatively short and coarse wire, and the other of a relatively long and fine wire, and both having such proportions that when the current of the working circuit divides between them their ampere-turns shall be the same.

575,419. Telegraphy. Patrick B. Delany, South Orange, N. J. Application filed April 21, 1896.

An automatic transmitter is adapted to be operated by a prepared tape or ribbon to send successive signaling impulses into the line; contact devices are controlled by the tape to make and break connection of the battery with the line, and to close the circuit of the battery after the passage of the tape, and means are provided for automatically preventing the short-circuiting of the battery at the transmitting station when the transmission of the message is completed.



NO. 575,346.

575,449. Telegraph Battery Jar. Andrew L. Werner, Delano, Pa. Application filed June 29, 1896.

A battery jar is provided with an integral spout, and has its rim formed into outwardly projecting hand-grasp flanges which extend almost completely around the jar, but leave a blank portion.

575,454. Series Multiple Controller for Electric Motors. Edward M. Bentley, Lawrence, N. Y. Application filed November 13, 1896.

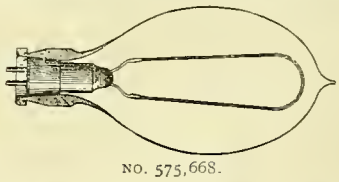
The device consists of a shunting resistance for each motor, an electro-magnet in the bridge-circuit between the two motors at a point between the inner terminals of the two shunts, and a circuit breaker in the bridge-circuit controlled by the magnet.

575,455. Deep Sea Electric Current Meter. Christian L. Berger, Boston, Mass. Application filed September 28, 1896.

An electric current meter is described, comprising a rotator, its shaft, bearings therefor and electrical make-and-break devices combined with an oil-well for the latter, the make-and-break devices being mounted in the upper portion of the oil-well, and the latter having an extended lower portion open freely below the make-and-break devices.

575,479. Electric Elevator or Hoisting Machine. Rudolph M. Hunter, Philadelphia, Pa. Application filed April 5, 1894.

The method of operating electric hoisting machines consists in supplying to the power motor an electric current, opposing to the current an induced counter electromotive force produced by magnetic induction independent of that of the power motor, and gradually increasing or decreasing the regulating counter-electromotive force from the moving cage or elevating device to vary the speed and power of the power motor and the movement of the cage or elevating device.



NO. 575,668.

575,490. Means for Operating Electric Motors. Jas. F. McLaughlin, Philadelphia, Pa. Application filed September 1, 1891.

The first claim reads as follows: The combination with an electric motor of a clutch for coupling it to the work, a brake for the motor armature, and connections between the clutch and armature brake for operating them in succession.

575,573. Electrical Controlling Apparatus. Oscar H. Pieper and Alphonse F. Pieper, San Jose, Cal. Application filed December 19, 1895.

There is the combination with the main containing case of a vertical spindle, a fixed switch-bar on the spindle, a series of contacts surrounding the spindle, contact segments whereby the integral brush short-circuits the armature terminals when approaching the central position.

575,615. Electric Motor and Device for Conducting Currents Thereto. David N. Osyor, Newark, Ohio. Application filed October 17, 1889.

In a system of electrical distribution, the combination with the positive and negative conductors of an insulating support, the brackets secured thereto for the conductors respectively, and the reversible holders interposed between the conductors and the brackets, and detachable from the conductors.

575,653. Electrical Condenser. John C. Lee, Brookline, William R. Wescott, Cambridge, and Ernest C. Robes, Medford, Mass. Application filed July 8, 1896.

This device is made in the form of a flat rectangular solid having rounded ends, and composed of alternate layers of a conductor and a non-conductor wound together to constitute plates and dielectric of like contiguity throughout, the conductor layers being provided with suitable terminal attachments.

575,668. Illuminant for Incandescent Lamps. Alexander de Lodyguine, Pittsburg, Pa. Application filed April 10, 1894.

The method described of forming illuminants for incandescent lamps consists in imparting the desired shape to a conducting fillet, immersing the fillet in a mixture of hydrogen and a gaseous chlorine compound of a refractory metal, and heating the fillet while so immersed.

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Electricity at the Cycle Show.

It is generally agreed that the Chicago cycle show of last week was the largest exhibition of bicycles and bicycle accessories ever held in this country. But its interest as an electrical display—that is, of profuse incandescent lighting for decorative and advertising purposes—was only second to the avowed object of the exhibition. It is estimated that in the whole show there were about 25,000 incandescent lamps of all sizes. In addition there were 200 arcs for general illumination and perhaps 30 or 40 small motors for running moving parts of displays. A lavish use of electricity was made both by the general management for decorative lighting and by a large proportion of the 600 exhibitors for signs or other display. The photographic reproduction on this page (Fig. 1) gives but a faint idea of the brilliancy of the general view from the gallery of the Coliseum when the lights were all on. A bewildering array of electrically lighted signs and advertising devices met the eye of the spectator. One of the most effective is shown in the foreground of the picture, where a concern making bicycle bells had an overhead string of large hand-bells. The handle of each bell was a frosted lamp, while the bell itself was a porcelain shade for the clear-glass lamp representing the clapper. Each lamp bore a letter of the sign, and the light was turned on intermittently. It was a simple but tasteful design, carried out consistently and well, and it excited a great deal of attention. Some of the signs were beautiful, like those of the Sterling, Stearns, Barnes and Columbia companies and others, while others were bold and dazzling, like the Crescent, Victor, Spaulding, Dunlop, Trinity, Monarch and Hamilton-Kenwood. One exhibitor, the Western Wheel Works (Crescent), used over 1,000 lamps, while many others employed several hundred each. One sign-making concern alone, the B. F. Chase company of Chicago, did over $5,000 worth of work for the show, and over half of this was for electric signs—a new departure for this company. A few of the simpler electric signs are shown in the photographic group reproduced in Fig. 2. The Chicago Edison company and other construction companies also supplied electric signs.

FIG. 1. ELECTRICITY AT THE CYCLE SHOW.—GENERAL VIEW OF EXHIBITS.

For the Cycle Board of Trade, which managed the show, the general scheme of electrical decoration consisted of festoons of Chinese lanterns, each with incandescent lamp enclosed, strung under the roof trusses and around the gallery. The central feature of the whole show was the beautiful pavilion illustrated by Fig. 3. Here alone were over 1,100 lamps. Above it was a great canopy of hunting with electrically lighted paper lanterns. There was also a beautiful flag of miniature lamps on the gallery for the musicians at the north end of the building.

Ordinarily the Coliseum is lighted by arc lamps alone, and 200 of them, supplied from the circuits of the People's Electric Light & Power company, are installed. There is no provision in the building for incandescent lighting and power, although there is a steam generating plant in a separate boiler house for operating the hot-air heating system, which is said to be the largest of its kind in existence, the air being forced around hundreds of miles of iron piping filled with steam. The building is about eight miles south of the city hall, in a residence district, where the demand for current is comparatively limited. With these conditions it will be seen that the task of getting enough current to operate, for a week, the 25,000 lamps in the show, within a reasonable limit of expense, was one presenting great difficulties and perplexities, especially when it is taken into consideration that the great bulk of the work of wiring for the exhibition, inside and outside of the building, and the erection of a large temporary plant, had to be done within the remarkably short space of time of two weeks. It was really an extraordinary electrical accomplishment, and the credit for the successful outcome is mainly due to the electrical engineer in charge, D. Avery Kimbark, who was retained by A. E. Pattison, the manager of the show, when it was seen that it would be impossible to do the work by contract. Mr. Kimbark is a very good type of the unceasing, well directed energy that has made the "Chicago idea" famous—a "hustler," in short—and the lights were burning on time. The expense was about $40,000. Mr. Kimbark has been prevailed upon to tell the readers of the WESTERN ELECTRICIAN how the problem was worked out, and many interesting details will be found in his article on the succeeding pages.

The temporary reserve plant, shown in Fig. 6 (p. 77), consisted of two second-hand Ideal engines of 150 horse power each, obtained from the Metropolitan West Side

Elevated Railway company, and three 1,000 light 110 volt dynamos rented of the Charles E. Gregory company. One of the dynamos was of the Edison bipolar type, while the other two were four-pole machines built by the Standard company. All had "seen service," but had been placed in good order by the Gregory company and worked satisfactorily. The engines were connected with the steam pipes of the Coliseum boiler plant. The switchboard was of wood, with Hill switches.

The list of the outside contributors of current may be tabulated as follows:

Name of Company or Plant.	No. of circuits.	Kind of Current.
Hyde Park Thomson-Houston Electric Light company	1	Alternating at 1,000 volts.
Hyde Park Electric Light & Power company	2	Alternating at 1,000 volts.
Englewood Electric Light company	3	Alternating at 2,000 volts.
Hotel Ingram	1	Three-wire direct, 110 volts on each side.
Park Gate Hotel	1	Three-wire direct, 110 volts on each side.

There were thus eight circuits brought into the building. The transformers for the alternating current were placed on poles outside the building, which also supported the feeder cables. A view of the temporary pole line on the east side of the Coliseum is presented in Fig. 4. On the west side there was a greater number of transformers, one pole having nine. Wagner transformers were employed, and several different sizes were used, ranging as high as 400 lights' capacity.

In the whole installation there was about 175,000 feet of wire, nearly all of No. 000 and No. 0000 sizes. The rubber-covered wire was mostly Okonite furnished from the large stock of the Central Electric company, which also supplied the transformers and switches. The Metropolitan Electric company and the Simplex Electrical company also furnished wire. A large proportion of the lamps used in the special sign work was supplied by the Sunbeam Lamp company.

Ten distributing boards, each controlling a section of booths, were located about the galley. A view of one of them is given in Fig. 5.

Of the exhibits, few were distinctly electrical. There were several new acetylene bicycle lamps, and at least three electrical outfits of this character. One that attracted much attention was the "lumino" bicycle electric light shown by the Leecol Storage Battery company of Chicago. This consists of a small incandescent lamp placed within a reflecting shade and adapted to be carried at the handle-bar of the wheel, or any other place within the limit of the lamp-cord. It is connected with a two-cell secondary battery, each cell having an electromotive force of 2½ volts. The battery is carried in a leather case, and the whole equipment is said to weigh but 24 ounces and to be capable of burning eight hours continuously without recharging. The Western Electric company displayed a primary battery lamp said to weigh 28 ounces and to be capable of burning 10 hours without renewing the battery. The Electric Portable Lamp company of Elmira, N. Y., had the "Chloride" lamp, using chloride secondary cells. This company claims that the light will last 12 hours without recharging the battery. It claims to have from the Electric Storage Battery company "the exclusive right to use storage plates in portable batteries." The electrolyte consists of "electric salt" dissolved in water

One exhibitor of cyclometers had one of his instruments attached to the armature shaft of a small electric motor revolving at very high speed, and was thus able to demonstrate the ability of his cyclometer to indicate a speed of 35 miles per minute.

The Independent Electric company of Chicago and the Julius Andrae & Sons company of Milwaukee were exhibitors, but not of electrical goods.

Electrical Problems at the Chicago Cycle Show of 1897.

By D. Avery Kimbark.

Those who attended the cycle show in Chicago this year can only in a measure appreciate the immensity of the undertaking to light the building, furnish current for display signs, automatic apparatus, motors and general illumination for the different exhibitors. It may be of interest to learn somewhat in detail what was necessary to install what now proves to have been the largest number of incandescent lights ever provided for in an equal space of time at any one place, the entire work having been done within three weeks, and practically four-fifths of the work within two weeks.

The work included the bringing of outside lines from three different central stations, and lines for the entire output from two different hotels in the vicinity, there being in all eight different outside circuits, from one to three miles in length, besides the setting within the building of three large dynamos, two large engines and all the necessary foundations, steam fitting, switchboard work and feeders, in addition to over forty sets of sub-feeders of No. 0000 wire, running under the floor to the various blocks of booths, from which were taken tap feeders to supply current for the various exhibitors. To fully appreciate what this means it is necessary to understand the immense area covered by the Coliseum building. The building is the largest enclosed space in one room in the world; in length about 750 feet, and in width about 350 feet, or, putting it otherwise, nearly two blocks long and one block wide.

To one familiar with the electrical business it is perfectly apparent that there was here danger of installing the sub-feeders at a great loss of copper. But what made it a still greater problem, and one almost incapable of solution, was the fact that the individual exhibitors had not made their requirements known; and, as the work was all under the floor, it would have been impossible, after the various platforms were laid, to have changed the sub-feeders in case of an overload at any one point. Then there were eight main supply circuits, beside the plant in the building, to be looked out for and the various sub-feeders properly apportioned to these different currents. It should be borne in mind, also, that these different sources of current were not decided upon all at one time, nor the quantity of current that was necessary to be arranged for. In the early stages of the work it was necessary to estimate, based upon the requirements made known up to that time, the probable necessities for the entire display lighting, increasing the supply from time to time as the requirements from exhibitors increased, pro-rata. Then, again, it was no easy task to properly apportion and place the transformers so as to supply these different feeders. These could not be put in place until the exhibitors had brought their electrical signs and other display apparatus upon the grounds and made their requirements known, because there was just so much current that could be furnished, and a misplaced transformer meant that some of the transformers would be overloaded and fuses would blow, resulting in no end of trouble. At such times each exhibitor thinks he is the only one without light; that he is "the only pebble on the beach."

But this is not all that was to be looked out for. Each exhibitor had his own style of apparatus, some for alternating and some for direct current; and frequently in the same booth would be a direct current motor with other apparatus requiring alternating current, so that it was no mean task to supply each exhibitor at his booth with just the form and amount of current that was needed. It became necessary to have feeders arranged for each block of booths so that either alternating or direct current could be furnished in any reasonable quantity. But all this has to do with the task of supplying current alone. In addition there were to be considered the decorative lights distributed about the building and across all the arches. The central pavilion of the National Board of Trade of Cycle Manufacturers, the main decorative feature in the building, alone had some 1,150 lights, and at the top of it were four revolving wheels illuminated with miniature lamps.

Under ordinary conditions it might require nearly six months to complete all the work outlined above. No contractor could be found who would undertake the job, with the uncertainty of the requirements as to the quantity of current. It was an absolute impossibility to arrive at any definite idea as to the amount of current that would be required. The only method by which the work could be done was to place a man in charge who should lay out the work as the estimated demands increased, buy the necessary material, employ the required labor from time to time in accordance with the increased demands over the previous estimates. No one could tell the cost; no one could tell the requirements, nor could anyone fix accurately the least time in which the work could be completed

All the signs and apparatus brought to the building by the different exhibitors were hung in place and wired to the taps from the sub-feeders within practically three days. Many of the signs were condemned by the city inspectors and had to be re-wired, and in some instances entirely reconstructed. But little apparatus came into the building in such shape that it could be installed under the Chicago fire rules. Nearly everything had to be remodeled before it could be used, and there was but three days' time in which to do it all.

The labor question was another of the difficult problems which required solution. There were carpenters necessary to put down the platforms, gas-fitters to put up the signs and hand-rails, painters to do their part of the decorating, and an army of electrical men to do the wiring. It was plainly evident that in order to complete the work before the opening of the show, after the Cycle Board had obtained possession of the building, it would be necessary to employ union labor, as in no other way could enough workmen of all the different trades be secured. Furthermore, the electrical department alone, which required by far the greatest number of men, would be unable to obtain a sufficient number of non-union men to complete the work within the allotted time. Accordingly, agreements were entered into with the electrical union; a trifling advance over the regular rates was agreed upon, and the union agreed, in turn, to furnish sufficient labor to do the work; and the statement was made by one of the union officials that they had telegraphed to other cities for men, and induced them to come to Chicago from as far west as San Francisco and as far east as Buffalo, N. Y. All the unemployed union electrical mechanics that could be found were at work at the Coliseum, practically day and night; and, had the requirements been a little larger, it would have been an impossibility to have obtained enough men to do the work in the allotted time.

Obtaining the necessary material on such short notice was another undertaking of no small moment. It is to be said to the credit of Chicago that nearly all the materials required for the job were obtained from stock on hand at the various supply houses, and one of the largest supply houses in Chicago is especially to be commended upon its ability to furnish upon the same day as ordered practically all the rubber-covered wire necessary for the mains and the greater portion of the weather-proof wire

FIG. 2. ELECTRICITY AT THE CYCLE SHOW.—A FEW LAMP SIGNS.

required for the outside lines, including also insulators, cut-outs and switches. But many of these fittings, on account of their size, had to be made especially to order.

The engineer in charge of the electrical work was especially fortunate in obtaining the right kind of a foreman to push the work. It is to be said in behalf of the foreman on the inside wiring that a job of its nature could not have been handled with more energy, promptness and care. The foreman in charge of the carpenters and the laborers necessary to install the conduits and raceways for the wires and cables, and to make the necessary cut-out boards and switchboards, is also entitled to praise for his strict attention to all the details. And it may be stated of the foreman on the outside lines that there is no one who has had a more extended experience, nor who has handled a greater amount of outside line work than he. Had it not been for the hearty co-operation of all branches in the electrical department, and the good will that the men showed (except, perhaps, in a few minor instances in the last day or two of the work by the inside wiremen), it would have been an utter impossibility to have anywhere nearly completed the undertaking.

The steam fitting that was done in connecting the engines may fairly be termed record-breaking. In less than three days the two engines were connected with the high-pressure supply of the Coliseum company, and with exhausts back into the heating coils, including all traps, oil separators, valves, and some special flanges made to order. The men worked over two days at a stretch, leaving their work only twice at midnight to eat. At the end of two days, after a short sleep, they completed the work at one stretch. It is estimated that under ordinary conditions, and with a force of men usual for such a job, two months would have been a fair time in which to have completed this steam fitting.

Ten days prior to the opening of the show it had not been determined that any plant should be set within the building. Up to that time, by the estimated requirements, it was thought that the current obtained from outside sources would be sufficient. But the management decided that it was essential as a safeguard, in the event of any trouble on the outside lines, or with the apparatus at the different central stations, to have an emergency plant within the building. The first day of the 10 was consumed in scouring the city for the proper dynamos and engines and in finding the proper foreman to install these and the proper men to set the foundations. Up to the ninth day prior to the opening of the show not one cent's worth of material for this plant had been ordered. By night of that day two 1,000-light dynamos had been delivered at the Coliseum, a third of the same size was ready to load on the wagon, and two engines necessary to drive these dynamos were loaded on wagons, and all were delivered the morning following, and also all stone, brick and other material necessary for the foundations; and within three days after the emergency plant had been decided upon the three dynamos and the two engines were set upon their foundations ready for steam connections.

Any steam engineer can appreciate what the above statement means. He will realize what it is necessary to get together in the way of lubricators and many other minor items, and to have these set in place, in working order, in such a short time. It can probably be truthfully said that such a thing has never been done before. It required extremely careful calculations to get the foundations properly set in time so that the machines could be safely placed upon them. One little item overlooked might mean that the plant would not run. The only slip in this connection, and it can hardly be termed such under the circumstances, was in the case of the belts. Upon the opening night, due to the heavy storm, telephone wires were down across the high-tension circuits of 1,000 and 2,000 volts, and some of the transformers in the hurry of the day had been misconnected, so that secondaries were 220 volts in place of 110, thus cutting off some of the stations, and it became necessary, in order to furnish the decorative lights for the building, which were the main feature of the exhibition, to run a dynamo in the emergency plant in the building. It was then discovered—that is, at about seven o'clock, one hour before the opening of the show—that one of the belts was about two feet too short. It became necessary to immediately remove the lag bolts and to move the dynamo, weighing about 6,500 pounds, 12 to 14 inches nearer to the engine. This was done, the dynamo lined up and bolted down and properly speeded in less than three-quarters of an hour. It should be said in this connection, however, that these belts had been properly measured and had only been delivered upon the day of the opening of the show, and there had not been sufficient time in the rush of the day to either try the belts or properly speed the dynamo.

Turning now to the actual lighting capacity that was arranged for in this installation, it may be stated that the entire amount of lights obtainable from the different stations, including the two hotels mentioned, and also the dynamos within the building, was practically 15,000 sixteen candle power lamps. In order to obviate any chance of overload at any point and to guard against uneven distribution and excessive drop, it was essential to install sub-mains for about 50 per cent. additional capacity above the amount of current actually obtainable, excepting at points where the actual requirements had been made known by the exhibitors; and in such cases only the actual current as needed was wired for. It was indeed difficult to keep posted up to the minute and enter upon the chart each application as it came in, to show at each booth the actual requirement of light, and, as the work was going on upon the sub-mains, to cut down or increase the capacity according to the applications as the work progressed. And even then, after all the care that was taken, when the current was finally turned on, one circuit was found to be considerable overloaded; but in putting in the sub-mains they were so arranged that two sets were tapped for each section of booths. Though this would throw the distribution a little out of balance it gave a chance of obviating an overload in cases where a section of booths had an excessive quantity and the adjoining section was using less light than the capacity of the feeders. So in this case of overload mentioned a portion of the excessive load was swapped over onto the other pair of feeders, which, as it happened, had a light load, and thus the overload was cared for. The actual carrying capacity of the sub-mains within the building was somewhat over 10,000 amperes.

It will readily be seen that, with this amount of current, unless the lengths of the sub-mains were made the shortest possible, the drop in potential would be excessive and the additional cost of copper enormous. Every sub-main within the building was put in on the axiom that "a straight line is the shortest distance between two points," and in place of running sub-mains lengthwise or entirely across the building, the building was divided in half throughout the entire length and the sub-mains worked from the center outward, feeding from both sides of the building. All of these sub-mains had to be placed under the floor, but on each side of the building the entire length there was a strip of permanent flooring about 65 feet wide which it was impossible to take up and replace in time for the show. In order to install the wires beneath the floor it was necessary to drive the largest sized iron armored conduit horizontally from the edge of the permanent floor across to the wall of the building.

It is easier to realize the work that was entailed in this connection when it is known that in driving this pipe with a four-cornered, pointed head on each run of conduit, with the pipe kept constantly turning by men with chain-tongs so as to keep it straight, two runs of this conduit were broken squarely in two in driving, resulting from the direct blows of the battering ram, bulging the floor above the point of breakage.

FIG. 3. ELECTRICITY AT THE CYCLE SHOW.—CENTRAL PAVILION, WITH 1,100 LAMPS.

The conduit had been ordered by telegraph at the earliest possible moment after the job was approximately laid out, but by some mistake in shipment the pipe was delayed two days and the management feared that this delay might affect its relations with the contractors for the platforms and railings, so that a force of men was held ready (the conduit having been received at noon on Sunday) to immediately pick up the work and install the conduit and connect in the sub-mains so that the floors could be laid. It is an interesting fact that all of this conduit was driven within seven hours from the time it arrived and that all but the two runs which were broken in driving were placed within five hours, the other two hours having been consumed in replacing the broken runs. Then, as the conduit was installed, the men were ready to immediately draw in the sub-mains so as to keep ahead of the force putting down the floor and platforms in the central part of the building. Perhaps it is not too much to say that never has a piece of

work been put through more quickly and more effectively. It went in as if by magic, and anyone having been at the building early Sunday morning and again early the following morning would almost feel that a miracle had been performed. Those familiar with the time required to handle No. 0000 wires and the large iron conduit will appreciate the magnitude of the task, which was, moreover, accomplished with less than the regular force of electricians and laborers employed in the building on the balance of the work. But there was hardly a man after that day's work who did not feel as though he had been working almost a week steadily without sleep.

The proper distribution of the transformers, and the wiring to them and connecting them after the exhibitors had arrived with their signs and apparatus and made their actual requirements known, and also the proper connecting and balancing up the different two-wire circuits in the building to the three-wire circuits from the two hotels, constituted a knotty problem. It must be remembered that it was necessary under the circumstances to practically place and connect all of the transformers within two days, and that the distribution of these transformers had to be varied for the exhibitors arriving late who had apparatus requiring a considerable quantity of current. The transformers were placed on poles outside the building. It took practically the greater part of the time of the engineer in charge during the day previous to the opening of the show and on the morning of the day of opening to properly portion out these transformers and keep changing and rearranging his plans according to the shifting demands of the exhibitors.

The exact sizes of transformers that were wanted in each case could not be had, and those that were obtainable had to be juggled around so as to make the different sizes do the work, in many cases it being necessary to bank them. Many of the transformers were as high as 400 lights capacity. The temperature outside while the men were working during these two days was many degrees below zero, with a high windstorm raging, and during one part of the time the temperature reached nearly 20 degrees below zero. Great bonfires were built at night in order to furnish heat and light so that the night work could be carried on and the men kept from freezing. No one but a lineman who has worked at the top of a 35 or 40 foot pole when the thermometer is down below zero, with the wind howling and the snow flying, can appreciate what these men endured.

Another difficulty arose from the fact that the voltage of the various plants was different, part being 1,000 primary and part 2,000, so that this had to be taken into consideration in placing the transformers. The six different circuits of alternating current had to be properly apportioned, and wires run around the building to connect at proper points. When the statement "around the building" is made, it should be remembered that the

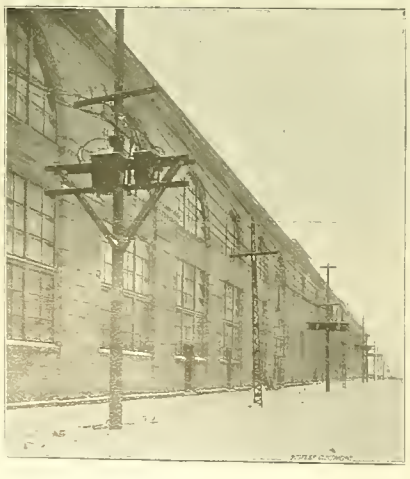

FIG. 4. ELECTRICITY AT THE CYCLE SHOW.—POLE LINE WITH TRANSFORMERS.

row of poles placed about the Coliseum made about a half mile run.

It would hardly do to omit mention of the arrangements made for the mains connecting the emergency plant within the building. Each leg of the emergency plant was wired for 1,000 amperes, and two separate circuits of three wires each were run to each side of the building, and from these taps were taken to feed to the various distribution switchboards, the idea being that it was impossible to tell where trouble might occur on the outside lines. Thus it was made possible to put the entire output of the emergency plant at either side of the building. Each sub-main running to the section of booths was provided with a double-throw switch so arranged that in case of trouble on the outside circuits the switch could be immediately thrown so as to connect to the emergency circuits. But all of these sub-mains to these various sections of booths were installed upon the two-wire system, while in order to save a large quantity of copper upon this emergency circuit and to give better voltage and less loss the entire circuit was made three-wire, so that it became somewhat of a problem to arrange the switches so that they could be balanced up as desired upon the two legs of the three-wire circuit. The difficulty of this will be especially appreciated from the fact that it was impossible to tell how much would be cut off at any minute due to trouble upon the outside lines, and on which side of the circuit the trouble might occur. So a tap was made from all three wires for each switch, the neutral tap being fixed permanently on the switch and the taps from the positive and negative poles each provided with a switch lug, so that in order to balance up the circuit all that was necessary was to remove the machine bolt and connect the other lug in on the switch in order to change to the opposite leg of the circuit. This was absolutely essential in order to prevent any prolonged interruption of service; and the necessity of it was proven the first night of the opening of the show, when, as before stated, some of the outside circuits failed and the dynamo had to be moved, and there was but a few minutes left to connect the proper polarity to the switches.

It may be noted that when the emergency plant was decided upon within the building the entire plan for the emergency circuit was changed, and the orders for switches which had to be made up were changed entirely. As has been stated, this emergency plant was not decided upon until 10 days previous to the opening of the show, and all material, wiring and special cut-out centers and the changing of the switches was obtained and installed within seven days prior to the show, everything having been practically completed in this work upon the day that the exhibitors commenced fitting up their booths.

Of many other interesting items of electrical detail, a few may be enumerated. The central feature, which had upon it over 1,100 different lamps, including the sign of nearly 600 lamps and the 30 wheels with eight miniature lamps each upon the rims, and the greater part of the automatic apparatus upon the top of the feature, were practically put in place and tested with the current within 24 hours of the opening night.

Another feature worth mentioning is the genuine cool-headedness or "nerve" that was shown by the men working upon the iron beams near the roof; and in one instance especially where it became necessary to suspend a large illuminated center canopy from the highest point of the roof, one man—the only man of the entire force of electrical men that could be persuaded to do so—crawled out on the narrow angle irons and made fast the necessary supporting tackle for this canopy. It is to be noted that the center point of the roof is about 85 feet from the floor.

The wiring and placing of the different apparatus and display lights of the various exhibitors within the available time was no small undertaking. Every electrical mechanic that could be found was at work during the days that the exhibitors were fitting up, and had there been a few more exhibitors with lights it would have been an utter impossibility to have connected them in within the given time.

Perhaps the most remarkable thing to be noted in connection with this work, in view of its exceptional character, is that after all the work was once installed, connected and properly tested, there were only one or two isolated instances where fuse links blew, and some of these were due to the fact that some of the exhibitors had erroneously stated the amount of current their entire apparatus would take. In each instance where the trouble occurred the wiring cut-outs and switches were of sufficient capacity, it being merely a question of the proper size of fuse links.

To summarize, in conclusion, the conditions of this unusual installation, of which it can probably be truthfully stated that it was the largest equipment of incandescent lights ever put in at one place in so short a time, it may be stated that, from the quantity of material required and the special fittings needed, it was utterly impossible in each case to get exactly what was wanted, so that it became necessary in many instances to substitute other material in place of that which was desired. Again, the entire current from the various sources was not arranged for at any one stage of the installation, but was taken on from time to time, so that where additional current was provided for, additional capacity had to be patched in upon the entire installation. But, with all these drawbacks, it was found that the entire scheme, as laid out for the wiring within the building and the arrangement of transformers without the building, and the distribution at the various switchboards, was so flexible that when the work was all completed the entire installation could be gone over and that it would look almost like one harmonious whole.

FIG. 5. ELECTRICITY AT THE CYCLE SHOW.—A GALLERY DISTRIBUTION BOARD.

Municipal Ownership.[1]

HENRY L. DOHERTY, chairman: Investigations warrant the statement that this is the most important subject for the attention of central station men, and every member of this association should feel responsible in aiding the work of demonstrating to the public that the municipal scheme is not practical, and that the majority of municipal plants if carefully investigated will prove to be gross failures.

We were instructed to confer with the electrical manufacturers and obtain their co-operation in preventing the misrepresentation as to cost of installation, operation and results obtained from municipal plants. All of the large manufacturers claim to co-operate with us, but in spite of their agreement they are not all supporting us. The opportunity offered them to hide behind the efforts of electrical engineers makes it possible for them to agitate and abet the installation of municipal plants without openly showing their hand. We therefore think the best evidence of good faith they can furnish the central station men of the country is to let this branch of the business alone. We therefore suggest that the committee carrying on this work be instructed to report at each meeting the number and locations of municipal plants installed, and the names of the manufacturers furnishing the steam and electrical apparatus. Persons in the electrical business whose opinions are based on observation cannot honestly claim that municipal ownership is apt to prove beneficial to the municipality; hence, the advocates of this plan must be regarded as either lacking the ability of observation, or else self-interest prompts their actions. All advocates of municipal ownership must be regarded as the natural foes of central station men and others who desire the welfare of the business as a whole. Central station men should patronize their friends, and they should satisfy themselves that their manufacturers are not aiding and agitating the establishment of municipal lighting plants and thus wrecking the property of some fellow central station owner.

We endeavored to obtain the co-operation of the National Electric Light association, but were unsuccessful. We regret the fact that it cannot see the advantage of a consolidation of interests, as we are both endeavoring to accomplish the same end.

We have also written the General Electric company, the Westinghouse company and the Fort Wayne corporation, requesting to know the number of municipal plants established throughout the Northwest during the last year where private stations already existed, and also the names of the manufacturers furnishing the steam and electrical apparatus.

We have had four appeals from central stations threatened with municipal ownership. As this is a public report, we think it well to withhold the location of all but one of these, which is Negaunee, Mich. In this case we did all that was possible to protect the central station owners, but the matter had progressed so far that apparently nothing was left except appeal to the courts, and we understand that the matter is now pending in the Supreme Court.

1. Report of special committee of the Northwestern Electrical association at Milwaukee, January 20, 1897.

At Madison, Wis., the establishment of a municipal plant was attempted, but the project failed, as sufficient votes could not be secured in the council to warrant the issue of bonds necessary to cover the purchase price of the plant. However, the advocates of this plan went as far as they could in the matter, accepted the bid of the Fort Wayne Electric corporation for a plant complete, and later on gave a second reading to an ordinance granting the Fort Wayne Electric corporation a contract for putting in a plant on the installment plan, as the lack of funds was all that prevented its installation. This last ordinance was never brought up for final action, as it was apparent that the parties interested could not secure sufficient votes for its passage, and the city made a one year's contract with the local lighting company.

We have endeavored to investigate the results obtained in the municipal plants already established, but find that this cannot be properly done except by sending a capable representative to these municipal plants. We have written for regular city reports, and have sent out blanks requesting answers to a number of questions asked. We find that in the majority of instances the expense report as covering the cost of electrical lighting does not cover such cost, as is evident from the fact that electric light expenses are charged under separate heads, and in but few instances does the city figure anything against the plant for interest, depreciation, taxes, water rent, office rent, management, fire insurance, employers' liability insurance and general risk. It is needless to say that by including only a portion of the expense of conducting an electric light plant, they can send out reports that look very inviting to other cities that are paying a fair rate for lighting their streets and houses. The easiest way to demonstrate the fallacy of this scheme is by making a personal investigation and determining just what portion of the expenses are omitted that should be figured against the cost of the city's expenses in operating the electric light plant.

In regard to the information gathered, we consider it advisable to hold it for the confidential use of our members and such central station men as are threatened with this form of opposition. By making the facts public nothing can be gained, and it allows the advocates of municipal ownership to avoid quoting such plants as they know we have evidence against.

ELIHU COLMAN (supplementary report): Your committee on municipal ownership of lighting plants is not bold enough to assume that it has compassed this entire question, or that its report will settle it.

We have much to contend with in dealing with the people. They have good reason to be cautious in dealing with electrical matters. Probably the majority of electric plants to-day were installed on a fictitious basis—with the capital stock much above the actual investment, and bonds issued to a vastly larger amount than the real investments. Representations of values did not materialize; confidence in these investments was lost, and even clean, honest securities could not be placed and are still at heavy discount. That was the era of promoters, and was quickly followed by the era of assignments, foreclosures and receivers. The former fraudulent transactions have been shown up, and the impression was left upon the public mind that electric light can be produced at a much less figure than is paid for it. We who are in the business know how far this is out of the way.

The third era of the business is now on, and the bondholder, the creditor, the purchaser at foreclosure sale and the honest investor are now on deck with the full understanding that only honest work will bring good results.

We must meet the agitators for municipal ownership with open hands, and when the people think judiciously on all sides of the question the agitation will cease.

Water works corporations and lighting corporations are from their very nature quasi-public corporations. They cannot operate without a franchise from the municipality. That franchise when accepted becomes a contract between the city and the corporation, and carries with it obligations binding both. The city signs it for two reasons: First, that private citizens shall put in the capital and produce the electric current to light the streets and public buildings, and, secondly, to light the houses and business places of the citizens.

If the company does its work well and in good faith, it has a right to expect good faith from the municipality. The company pays its taxes, furnishes good light, and is a booming card for citizens to boast of. Is it equitable on the part of the city to enter the field against such a company and as a competitor to it, merely because with its help the city treasury has become plethoric and it can build its own plant? On the other hand, if the company, after receiving its franchise, has only played the role of a leech, then the city fathers should cause its franchise to be judicially annulled and proceed to build its own plant, or to do what is better, contract with a reliable company to furnish the city and its citizens with equitable but living rates.

Your committee does not venture the opinion that the municipality has or has not a legal right to thus destroy the value of the local plant. That question must be settled by the terms of the franchise itself. All will agree that the city has neither the moral nor the equitable right to do so.

It is, therefore, certain that the municipality should not be given the power to put in a plant unless, first, the existing company shall be bought out, or second, its stock bought up, or third, if agreement to purchase cannot be made, that process of condemnation be had under power of eminent domain as in railroads. While hardships might come to some, these methods would all be fair and equitable. The remaining questions are these:

First—Is municipal ownership practicable?

Second—Will it be remunerative?

The office of a town or city is not to dig our potatoes, cut our wood, or chop our hash, or to do any of the ordinary work of life, but its office is to do for all its citizens such work as individuals or corporations cannot do for themselves, such as furnishing protection, building and maintaining streets and furnishing water and lights. The two latter duties can better be done by the quasi-public corporation in most cases than by the city itself, and these franchises are given to corporations to relieve the city of an additional swarm of bloodsuckers, both political and personal.

In the financial phase lies the greatest objection to municipal ownership:

First—A commission (non-partisan, of course) must be appointed.

Second—A manager must be hired.

Third—An expert electrician must be had.

Fourth—Duplicate machinery must be put in, for commissions, boards of experts and common councils can keep no pace with electrical current, machinery or men.

Fifth—If the public plant furnishes electricity for private consumption the citizen will forever be hounding the manager for rebates political, rebates special and rebates on general principles.

Sixth—The manager and manufacturer will put their heads together to fool the board, and the public bleeds at every pore.

Seventh—If the ever alert central plant manager cannot keep pace with the rush of improvements, where will the foregoing crowd be left?

Our conclusions are then as follows:

First—That legislatures should grant no powers to municipalities to erect and maintain lighting plants for general use, unless, where franchises have been given, the owners of the same shall have been remunerated as herein set forth.

Second—That honorable manufacturers will not sell to municipalities until these steps have been taken, and central station men cannot afford to deal with manufacturers showing themselves thus dishonorable.

Third—That if we cannot show to municipalities that the business is unprofitable to a city, including of course the item of taxes, lost interest on investment, depreciation, etc., then we should be silent.

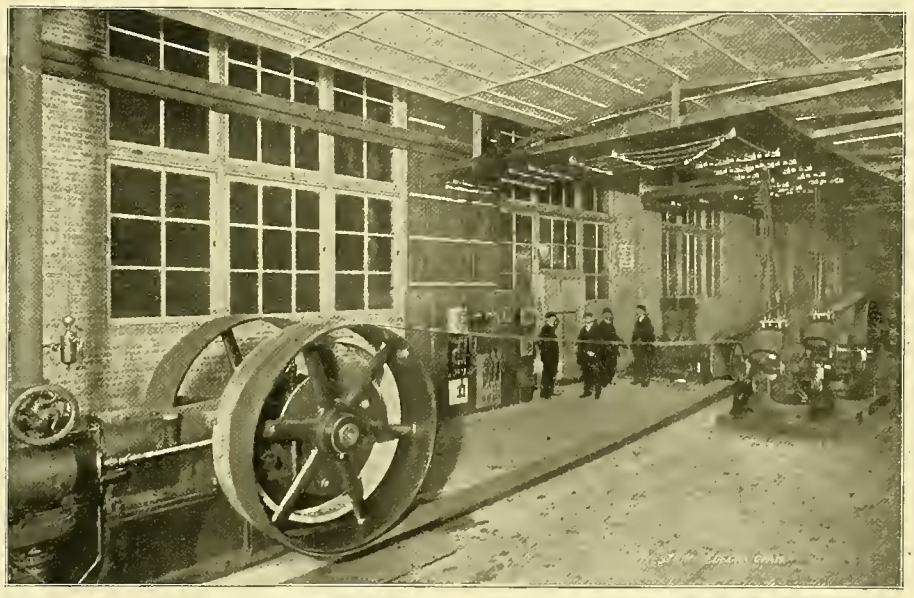

FIG. 6. ELECTRICITY AT THE CYCLE SHOW.—TEMPORARY RESERVE PLANT.

DISCUSSION.

MR. DOHERTY: In regard to obtaining the co-operation of the National association, I would say that I wrote to Mr. Nichols, the president of the organization, after our meeting at Marinette, and told him that the association had taken up this matter and had appointed a committee to gather facts, figures, etc., and suggested to him that we do our work jointly. He wrote back signifying a willingness to co-operate, but later on he came out point blank and said that unless I joined the association I could not have the reports. I agreed to join the association and called his attention to the fact that it would be probably better, as the amount of funds I had to spend on this work was limited, to apply the cost of the initiation fee in the National association, $25, in doing the actual work; but I said, however, that we wanted the reports, and if we could not get them any other way I would join the association. I sent my application in and they wrote back and said that it would stand in the name of the Wisconsin Gas & Electric company. I then withdrew my application and told them I did not want it to stand in that name, but that if Mr. Baker, president of the association, was willing, I would apply for membership for the Northwestern Electrical association and pay for that membership. I wrote to Mr. Baker; he objected, and so the matter was dropped there.

W. J. BUCKLEY: I have been identified with the Fort Wayne corporation ever since it was started, and I am very glad indeed of an opportunity now to say that the Fort Wayne Electric corporation as well as myself take the position that municipal ownership is a fallacy and a failure; that a majority of all the municipal plants that have been erected are failures in that they have cost the cities that have built them more money to operate per light than the local companies offered to give them light of equal service for. It is not in the province of this association, nor is it in the province of the central station manager whose station and whose property is jeopardized by this municipal ownership idea, to attack the manufacturers of apparatus or to directly look to the manufacturer of apparatus for the cure of the threatening disease. Municipal ownership is a fallacy, a fad, an idea, whatever you may choose to call it, that exists. We as manufacturers, or the association as a body, or central station men as individuals, cannot prevent the existence of the municipal ownership idea. We must face the fact that it exists. What then is the method to be employed to protect our property? Not by boycotting or attacking the manufacturers, because the manufacturers are in a much different state to-day, and the art is in a much different state to-day, than five or 10 years ago. A city wishing to buy a plant usually wants arc lights. In that case it can get bids from but three companies, the Brush Electric company, the General Electric and ourselves. If it wants incandescent lights then, of course, we must include the Westinghouse company, and I am sure that prices on apparatus are such, and the profit in our business is so small, that we cannot afford to do anything that is so diametrically opposed to the interests of our various organizations as to sell to any municipality that is going to deprive us of the revenue from the central station men. Now instead of taking that position, if you will face the municipal idea first, you will do well. How should it be managed? By doing exactly what this committee has done, obtaining the information that will prove to city councils that when you offer them electric lights at a fair price, they cannot afford to establish their municipal plant. Now how to get at that in the readiest manner, is the question. The first thing that is almost invariably overlooked by every central station manager—not by all, but by almost all—is the fact that he does not cultivate the council. That is the first thing to do. He forgets, or does not know, that it is just as essential for him to become acquainted with every member of that council, to be a good fellow with them and to use every means in his power to obtain a standing with them similar to what Mr. Grover evidently has in Fond du Lac. He says that he goes to a man who intends to wire a building, and says, if such is the case, that the wiring is not right and the man does not put it in. Now, if you come to your councilmen fortified with this very information which the committee has been collecting, the councilmen, being fair minded, will pay a fair price rather than adopt a business proposition for the municipality that you can prove is not a good one. Now Massachusetts has set the best example of any state in this Union for the handling of this question. The various central station managers there combined, formed a purse, sent their representatives to the Legislature, and the Legislature enacted a law providing that any municipality that wishes to operate its own electric lighting plant must first receive and consider the proposal of a local company for such parts of its equipment as may be applied to a city plant. If it refuses the proposition because the price is not right, the city selects an arbitrator, the central station man selects an arbitrator, and those two fix the price which the municipality is compelled by this statute to pay the local lighting company. Now the same plan, I think, should be followed here. I think this association should appropriate first enough money for this committee to obtain the necessary information so that it can absolutely prove to the aldermen that when they have offered a fair price the city cannot afford to install its own plant. If there is any other reason, if it becomes a personal fight, of course it must be governed by local conditions. After this appropria-

[*Continued on page 83.*]

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HIGH WATER MARK

CIRCULATION, 16,630.

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MUCH suffering and hardship resulted from the recent severe weather especially in the West and Northwest. The experience emphasized the necessity of furnishing protection for motor and gripmen on electric and cable cars. Vestibules are provided in many places, and while they may not give absolute and complete protection they afford shelter in a measure at least from the penetrating cold. Some such contrivance should be insisted upon in every northern city. To require men to expose themselves to positive suffering in order to earn a living, when protection can be afforded, is simply barbarism and should not be tolerated in any civilized community.

ON another page this week is presented a comprehensive report of the discussion on the subject of "Municipal Ownership" at the Milwaukee convention of the Northwestern Electrical association. The reports of Messrs. Doherty and Colman and the comments of Messrs. Buckley, Schuette and Pearce may be taken as a fair indication of the views entertained by the members. Mr. Buckley, it will be noticed, deprecated any organized movement against corporations that sold apparatus to city plants, although he professed to be in sympathy with central station managers and opposed to municipal ownership. There can be no doubt that the views of the great majority of members were expressed by Mr Doherty when he said: "All advocates of municipal ownership must be regarded as the natural enemies of central station men and others who desire the welfare of the business as a whole." It is not to be wondered that the discussion at times assumed a tinge of bitterness, when the experience of Mr. Pearce and others is taken into consideration. In view of all the facts in the case it must be admitted that the discussion was exceedingly mild in tone.

LEGISLATIVE action will be sought by the anti-Bell forces in Illinois to require the Chicago Telephone company to give city connections to independent companies operating throughout the state. At the present time, it is claimed, the Central Union company alone of all the telephone companies doing business throughout the state is given connections over the Chicago company's system. A bill has been prepared which declares all telephones, whether leased, owned or operated by individuals, copartnerships, or corporations, to be common carriers. It is directed that every telephone company shall permit any other person or corporation operating a telephone line to connect with its wires by any device or system commonly used for local or long-distance telephones, and shall receive and transmit all messages that may be offered by the connecting company, and shall repeat or cause to be repeated as many times as may be necessary to a proper and distinct delivery of the message. It is provided that any person or corporation desiring to connect with the telephone wires of another person or corporation may do so by giving five days' notice and paying the expense of making the connection. Rates of compensation are provided for and many other details arranged. This is said to be intended as the opening wedge to be followed by other legislative action in the same line. A well organized, aggressive warfare upon the Bell companies is promised at Springfield this winter.

IF the provisions relating to public franchises suggested by the Greater New York commission are incorporated in the charter of the enlarged municipality, the example will have considerable influence upon other cities. Under the proposed arrangement no more grants in perpetuity to street railway companies shall be made by the city. Twenty-five years was fixed as the limit of time that all of them shall run. Franchises for street railways will be sold at auction as now, but the purchaser must bid with an understanding that at the end of 25 years the city may take the property and operate it. In event that the city does not elect to take the property the purchaser will know that the lease may be renewed for another 25 years, when the city will again have the right of taking the road or leasing it. In case the city decides to operate the road it will not confiscate the property, but it will pay a fair valuation to be determined by a method set forth in the original terms of sale, and in case of renewal of lease, the railroad will not secure the privilege of continued operation of the road on the original terms. Increased payment for the privilege will be insisted on. Just what amount will be received by the city in case of a renewal of franchise will be determined by the increased value of the privilege. Vested rights of existing railways cannot be affected by this new arrangement. It would seem as if the fact that the street railroad company had contributed to the increased valuation of the franchise and of the property in the district through which the road passed should relieve it from additional burdens proposed by this section of the new charter.

THE contract for the fire-alarm boxes for the city of Chicago which has been the subject of much interest in electrical circles for several weeks has finally been awarded upon the recommendation of John P. Barrett, and, as might be expected under the circumstances, the highest bidder secured the prize, as it was the company in which Barrett has shown so much interest. Under the terms of this contract the successful bidder is allowed $4,100 more than the price at which another company agreed to furnish apparatus guaranteed to be equal in every respect to that adopted. It is also claimed, and has not been denied, that the same style of boxes as that adopted by the city of Chicago has been furnished by the same manufacturer to other cities at much lower figures, notably Cleveland, which recently purchased 10 boxes at $50 each.

The action of the city electrical department in this matter is not a disappointment to this journal, as it is in keeping with the record of the present administration and very clearly illustrates the boldness that marks many transactions of a similar character at the city hall. This time, however, Barrett was caught fairly and squarely, as is clearly shown in the detailed account of the transaction which is presented on another page of this issue, and the only course left for him was to put the deal through in a brazen manner, which he adopted. It will be observed that he attempted to divert attention from himself and shift responsibility by getting the mayor to directly sanction the action of the department, but that scheme will not be allowed to succeed and Barrett may as well understand that no more contracts will be awarded through his department without full publicity being given the details of the transactions. Furthermore, the new mayor of Chicago will have an opportunity before election to declare whether he favors fair competition in the city electrical department and whether he will insist upon compliance with the spirit and the letter of the law. Interest in this subject has now spread beyond electrical circles and Barrett may find that the general public will not be as lenient with him as the electrical interests have been. The *Chicago Record* has taken up the investigation and it deserves special commendation for the course it has taken in exposing the methods employed in Barrett's department. Can Barrett dismiss the *Record's* arraignment of his administration by accusing that journal of being actuated by spleen, personal hostility and malice? Or will he realize that the lines are closing in about him, that opposition to his high-handed and disgraceful methods is growing daily and is becoming more and more determined, and that he can no longer dismiss grave charges by assailing the character and motives of those who exercise only their undoubted right when they criticize an unworthy public official?

WHAT is the Cosmopolitan Electric company going to do? What are its plans? Who are its backers? These questions have been asked frequently since announcement was made in the WESTERN ELECTRICIAN of the progress already made by the company in its preparations to take advantage of the valuable franchise which it possesses. The project has been regarded with suspicion ever since the ordinance granting it such unusual privileges was first proposed in the Chicago City Council. The granting of this franchise raised a storm of opposition and Mayor Hopkins was denounced for approving it. There was considerable discussion at the time of the alleged plans of the promoters of the project. Many schemes that were then pending, including a new telephone system, were thought to be in some way connected with the Cosmopolitan deal, but as none of these materialized interest in the ordinance soon ceased and the entire subject had passed from the public mind when the application to the commissioner of public works for permission to build conduits in the streets of Chicago revived interest in the affair. Then it was learned that the company had already secured the use of the conduits of the West Park commission and had already done considerable work along the boulevards of the West Side. When the facts relating to this transaction became public, it must be confessed that confidence in the company was not restored. The belief gained ground that the enterprise was really another attack upon established corporations and that the activity thus far shown was merely for the purpose of making the company now occupying the territory absorb the new company.

On the other hand the men interested in the project claim that it is a legitimate enterprise and that it has ample financial backing. They point to the fact that the company has already invested at least $200,000 in material and labor for underground construction, and that it is prepared to extend its system throughout the business district of the city and establish a power plant as soon as the commissioner of public works will allow it to complete its work of establishing an underground system. The company has not been obliged to borrow money or issue bonds, and all who have had any dealings with it seem to be perfectly satisfied with the financial standing of the corporation. It is admitted that the owners of the Ogden gas ordinance are behind the Cosmopolitan company, and this is not considered detrimental to the project, as the Ogden company is carrying out the provisions of its franchise, and to-day, according to its officers, is supplying more than a thousand consumers on the North Side. The Cosmopolitan company says it has already received applications from many residents and business men on the West Side for electric lights, and that there is a real demand for its service. Heretofore, it is claimed, the territory which it proposes to occupy—the West Side—has in a large measure been disregarded by the local Edison company, as the latter was fully occupied with its down-town business. It must be admitted that the new company, despite the suspicion with which it has been regarded all along, is now considered an important factor in the electrical business of Chicago. Further developments will be awaited with interest.

Barrett's Methods Exemplified.

Readers of the WESTERN ELECTRICIAN who have followed the situation brought about by the recent bidding on the fire-alarm contract in Chicago, as detailed in this journal, and who are acquainted with the character and hardihood of John P. Barrett, will not be surprised at the news that he has reported to the fire marshal in favor of accepting the bid of the Police Telephone & Signal company for fire-alarm boxes at $100 each, rejecting the bid of the United States Fire & Police Telegraph company of $45 for each box. As has been pointed out, the acceptance of the lower bid for the 75 boxes would have meant a saving of $4,125 to the city of Chicago. There should be a very good reason for spending such a sum of money, but the truth is that dozens of fire department officials in other cities testify that the United States box is equally as good as the Gamewell box, so that Barrett brought about a sheer waste of $4,000, to use no barsher term. He is believed to be interested in the company which he favors, in his official capacity, to the extent of $4,000, and he screens himself behind the report of the superintendent of the city repair shop, who invented and sold to the Gamewell people the device in their box on which he passes and which he pronounces to be worth $55 for each box in which it is used. The situation is shameful, and it is evident that the WESTERN ELECTRICIAN is not alone in thinking so, for the *Chicago Record*, the cleanest and most independent newspaper in the city, devotes columns of space to the matter in its issues of January 30th and February 2d. On the former date the *Record* said:

Prof. John P. Barrett, superintendent of city telegraph, sent to Fire Marshal Swenie yesterday a report on the inspection of sample fire-alarm boxes submitted in the recent proposals for 75 boxes. He recommended that the bid of the United States Fire & Police Telegraph company, of $45 a box, be rejected, and the bid of the Police Telephone & Signal company, of $100 a box, be accepted. The latter company is western agent for the Gamewell Fire-alarm Telegraph company of New York, and bid on the regulation Gamewell box. Marshal Swenie intended yesterday to award the contract according to the recommendation.

The city has never used any alarm boxes except those manufactured by the Gamewell company, and has paid $100 a box. Rival companies have been prevented from bidding on contracts by the specifications drawn by Prof. Barrett and Marshal Swenie. These have usually called for a Gamewell box or an exact duplicate.

The recommendation of Prof. Barrett is based on a report made by Jacob F. Mehren, superintendent of the city repair shop, who made a personal test of the samples. The Barrett and Mehren reports both say that the chief superiority of the Gamewell box lies in the device for protection against lightning and high-tension currents from trolley wires and other crossing circuits. This device was invented by Superintendent Mehren in 1893, and the patents assigned to the Gamewell company by him before they were finally issued. They are the only unexpired patents on the Gamewell box. The patents are as follows:

Nos. 494,786 and 494,787, April 4, 1893. Automatic cut-out for electrical signaling. Jacob F. Mehren, assignor to the Gamewell Fire-alarm Telegraph company, New York and Chicago. Filed February 8, 1892.

Prof. Barrett himself has been intimately associated with the Gamewell people during the last 13 years. He organized the Police Telephone & Signal company, for the purpose of furnishing the police patrol boxes used by the city. This company has another bid in for 25 patrol boxes at $75 a box. The Gamewell company has lately secured a controlling interest in the local company, and Prof. Barrett has sold many patents to this company.

The Mehren patents cover only the particular form of cut-out used in the Gamewell box. It is a combination of cut-out, telegraph key and lightning arrester. James W. Johnson, western agent for the United States company, which is a Boston concern, claims that his boxes have a lightning arrester which has proved superior to the Mehren device in cities where the two forms of boxes have been used together. Reports received from various municipal authorities through the country are said to sustain his claim.

The decision of Prof. Barrett favoring the Gamewell box was expected, since the department from the first showed a disposition to shut out competition in the bidding.

* * * *

In addition to what he claims is the inferiority of his rival patent, Mehren criticises the general workmanship of the United States box. One serious defect, he says, is in the aparatus for pulling the box. This, he says, is not reliable. Agent Johnson, in order to satisfy the department officials, and meet the specifications as nearly as possible before submitting his sample, had his regular apparatus changed, and the exact Gamewell apparatus put on, so that the sample in this respect is identical with the Gamewell box. Prof. Barrett, in his recommendation, speaks at length of the necessity of having reliable boxes at any cost, and declares that the Gamewell has the most efficient protection known against high-tension currents in the lightning arrester and test key switch. Marshal Swenie declined yesterday to allow the publication of the reports.

On Saturday Chief Swenie said that he had referred the whole matter to the mayor, including the reports of Mehren and Barrett. He says that he is not an electrician and is not in a position to dispute the correctness of the finding of the superintendent of city telegraphs. However, on Monday the award was made to the Police Telephone & Signal company, thereby entailing a needless expense of $4,000 on the city and showing very conclusively the rottenness of the methods of Barrett's department and the culpable negligence of the mayor.

Mayor Swift is said to have rejected a proposition to have the sample Gamewell and United States boxes tested by a commission of distinguished experts and their respective merits fairly determined. James W. Johnson, western agent for the United States company, stood ready to turn the check of $500 which he deposited with his bid into the poor relief fund, if such a commission should decide that his box was inferior to the favorite of the fire department. Mayor Swift declined to make an appointment, the *Record* says, pleading that he had no acquaintance with electricians outside of the fire department.

Notwithstanding Swenie's statement of Saturday that he had turned the whole matter over to the mayor, the latter is reported in the *Record* as saying on Monday that Swenie told him that the use of the $100 dollar box instead of the $45 box would save money to the city. Swenie, of course, refers to Barrett as his authority, while the bold "professor," the head plotter, tries to screen himself behind his repair-shop superintendent.

It is a very pleasant state of affairs for the taxpayers of Chicago to contemplate, and the uncontroverted fact that Gamewell boxes are sold in other cities for $50 each adds to the charm of the situation.

Ordinance for Trolley Conduit Roads in Chicago Accepted.

If appearances are not deceitful, Chicago will not be far behind New York in the introduction of trolley conduit electric railways. The ordinance granting the right to the General Electric Railway company to use many South Side streets for this purpose, which had passed the council on January 25th, as noted in the WESTERN ELECTRICIAN last week, has been amended acceptably to the mayor and the council, and was accepted by the company on February 1st. To adapt a recent campaign aphorism to the situation, everybody is pleased but the people. The General Electric Railway company has surrendered its right to the overhead trolley granted in the first ordinance, passed in January, 1896, and agrees to confine its electric construction to the underground system, except upon unimproved streets, and to abandon the overhead system within two years after the improvement of a street. The compensation which the mayor secured to the city will run as follows: For the first five years, nothing; for the second five years, five per cent. of its gross receipts from the carriage of passengers; for the third five years, 7½ per cent., and for the last five years, 10 per cent. The agreement provides for transfers on all lines authorized under both ordinances; for the use of grooved rails; that the company shall not couple more than two cars in a train, and that the cars shall be furnished with some reasonable device to protect the motormen in bad weather.

Chicago Electrical Association.

The winter and spring announcement of the Chicago Electrical association, just issued, gives the following list of papers to be read before the organization:

February 5th, "The Telephone Situation," by W. Clyde Jones.

February 19th, "Vacuum Tube Lighting," by M. A. Edson.

March 5th, "Electrical Resonance," by Kempster B. Miller.

March 19th, "Cable Testing," by Geo. D. Hale.

April 2d, "Requirements of High Speed and Heavy Electric Traction," by Hayward Cochrane and E. J. Swartout,

April 16th, "Arc Lighting in America and in Europe," by C. Wiler.

May 7th, "Direct Current Transformers," by C. H Thordarson.

As is customary in this association the season's work will be closed with a banquet. This year the event will take place on May 21st.

The Savannah (Ga.) Traction company has been reorganized, with Herman Myers, president; J. H. Fall, vice-president, and T. G. Reid, secretary and treasurer. The new company will make extensive improvements by the erection of a new power house, etc. The amount of new stock is to be about $50,000.

Cause of Tanning of the Skin by Röntgen Rays.

BY W. M. STINE.

A case of tanning has recently occurred in the laboratory of the Armour Institute of Technology which is of especial interest at this time, when so many persons are recording effects of Röntgen tubes on the skin, and ascribing these to such various causes. An attempt was made to pierce a heavy plate of cast-iron with the electrical arc. The experimenter fastened the carbon rod in a short holder and grasped this with his hand, protecting it from the heat by a piece of asbestos mill board. He protected his eyes with colored glass, but took no precautions to screen the face from the light. Two holes were pierced through the iron, and the heavy current employed made a most brilliant arc, and this, due to the incandescent iron, was usually blue, and by inference emitted powerful ultra-violet light The exposure to this light did not last quite three minutes. Within 24 hours the face grew red and inflamed, the effect being similar to that produced by long exposure to the Röntgen rays. The case has gone through all the phases of a bad sunburn, and the skin finally peeled off.

A distinction should be made between mere sunburn and superficial inflammations. In the one case the dermis only is effected, while in the other the subcutaneous tissues are involved. This latter may result in suppuration and usually a blister forms. Both the blister and tan can be produced by the sun's rays, and, as has just been shown, by the rays of a strong arc light. The cause here is certainly not chemical, but rather due to ultra-violet light waves.

The proposition that the effects following exposure to the Röntgen tubes are due to ozone or oxide of nitrogen formed on the body is at variance with the well-known action of this active form of oxygen; its peculiar property is to bleach rather than to tan. Besides, there is no experimental evidence that ozone is so produced. It is present in the air when tubes are powerfully excited, but there is no reason why it should not equally affect the operator and patient.

The more probable explanation is to attribute such skin effects to the action of ultra-violet rays, which, experiment has shown, occur associated with the production of Röntgen rays when a focus tube is excited.

Chicago Electrical Men's Banquet.

Invitations have been issued for a banquet of the electrical men of Chicago at the Union League Club on Wednesday evening, February 17th, at 6:30 o'clock. The affair is in charge of a committee composed of B. E. Sunny, Charles A. Brown, Samuel Insull, W. H. McKiclock, Angus S. Hibbard and F. B. Badt. Every interest in the electrical industry will be represented at this affair—and it is proposed to have a number of speeches upon subjects of general interest to the trade. The committee found difficulty in preparing its list of persons to whom cards should be sent, and it desires to have the names of any who may have been overlooked forwarded at once to F. B. Badt, 1215 Monadnock building, in order that cards may be sent in season. The arrangements for the after-dinner speaking and other features of the gathering are not yet completed, but it is expected that they will be ready for announcement shortly. The dinner will be served in the tower room of the Union League club house. The price of tickets has been placed at $7.00.

It is believed by the promoters of the affair that it will have the effect of bringing together the several elements of the electrical industry of Chicago and have them work in harmony. It is pointed out that there has been no gathering of electrical men of this kind in Chicago since the disbandment of the Chicago Electric club.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

Allan Tompkins contemplates establishing a telephone exchange and electric light plant at Minot, N. D.

The city of Worthington, Minn., and the telephone company are at outs, and telephone communication there is likely to be delayed some time. The wires are connected through the town but the local exchange is not put in. The location of the poles is the point of difference; the company wants to put them on the main street and the council wants them in the alleys.

The Buffalo Center, Ia., Telephone company has incorporated and will put in an exchange at once.

The Enclosed Arc Light.[1]

By L. B. Marks.

Part I.

The unprecedented industrial utilization of the enclosed arc light in America during the last two years has aroused the attention not only of American electricians and engineers, but of scientists the world over. Although some of the earlier inventors in this field achieved a modicum of temporary success, every attempt to introduce the enclosed arc lamp commercially eventually met with decided failure.

Before going into the details of the subject or presenting a sketch of the earlier history of the art of enclosed arc lighting, it may not be amiss to point out the characteristic distinction between the ordinary arc and the enclosed arc. The ordinary arc, commonly known as the open arc, is generally enclosed in a globe more or less tight at the top and bottom. This is also the case with the enclosed arc. In the former, however, the arc depends for its efficient operation upon an excess of air or oxygen-bearing gas, while in the latter provision is made for the partial or total exclusion of the atmosphere. With this preface I shall now revert for a few moments to the earlier forms of enclosed arc lamps.

Historical Sketch.—The history of the art may be said to date back to about 1846, when William E. Staite first produced an enclosed lamp in which one carbon was supported on a rod passing through an air-tight bushing into a globe, and the other carbon mounted in a tube projecting through the base of the globe, and fed by a rack operated by clock-work. In this lamp the arc was struck by pushing the carbons apart by hand. At that early date Staite pointed out that "the more rarified or deoxygenated the air around the point of ignition is, the more continuous and brilliant the light; hence, may be deduced the propriety of enclosing the electrodes in a vessel of small dimensions hermetically sealed from the external atmosphere, but with a valve in it for the escape of the included air when the expansion begins to exceed those limits which experience may show to be compatible with the safety of the apparatus."

About a year later Staite improved this lamp in various details. Instead of springing the arc by hand, it was done automatically by an electro-magnet. The arc was enclosed in an air-tight globe and the regulation effected by electro-mechanical means.

After Staite's experiment there followed a period of inactivity in this line, and it was not until the '70's that the work was again zealously taken up. In 1878 F. H. Varley brought out a lamp containing an air-tight chamber in which carbon powder was allowed to fall from one electrode to another as from an hour glass, the carbon being heated to incandescence in transit. The mechanism of the lamp was so arranged that the carbon, after falling through the arc space and becoming incandescent, was again returned by suitable carriers to go through the same operation. In 1879 George G. André devised an electric lamp in which the carbons were enclosed air-tight in a large globe, no provision having been made for egress or ingress of gases. The oxygen of air in the globe gradually combined with the volatilized carbon, when the lamp was in operation, until finally the electrodes burned in an atmosphere consisting largely of carbon gas.

About this time there was considerable activity in the production of enclosed arcs of a different type, viz., the semi-incandescent arcs. In this form, the carbons or other electrodes, as the case may be, are in imperfect contact, the point of juncture being heated to a state of incandescence when the current is passed. Such was the lamp of Brougham, in which the carbons were enclosed in a receptacle from which the atmosphere was excluded; no arc was sprung in this lamp, the light emanating from the incandescent points. Following closely on this, in the year 1880, André and Easton produced a lamp similar to the older type already described, but differing from the latter in that the movable carbon was maintained in contact with the negative in a closed chamber, and was fed upward as the carbons burned away, the feed being effected by a weight released by a magnet acting on a friction disk. The same type of lamp is also described by Hedges, who substituted a metal disk for the negative carbon, the positive carbon feeding and continuously bearing against this metal disk, and heating the joint to incandescence.

The well known lamp of Werdermann, which was brought out in 1882, is another type of the typical incandescent arc. In Werdermann's lamp the carbons were enclosed in an air-tight globe. A thin carbon pencil was propelled against a large negative electrode by a spring; the pencil passed through a block of magnesium or other refractory substance, and a considerable length of the electrode between the block and the contact was rendered incandescent. After the lamp was started the oxygen contained in the globe quickly combined with the carbon, the residual gases thus consisting of nitrogen and carbonic oxides. Among other lamps of the same type, in which no true arc was sprung, were the earlier forms of Janson in 1875 and Scott in 1878, and subsequently those of Rapieff, Nordenfeldt, Pilleux and Quesnot.

The record of development between 1880 and 1884 shows that a number of lamps of the enclosed type in which a true arc was sprung were produced. The principal ones were that of Varley, in which the arc was enclosed in a glass globe or shade filled with carbonic anhydride, or hydrogen, or dried nitrogen; those of Wallace, Brewer and Menges; that of Beardslee, in which the arc was enclosed in a small globe, air-tight at the bottom and having a contracted neck at the top through which the movable carbon passed; that of Baxter, in which the entire lamp mechanism was enclosed air-tight, provision for the egress of heated gases under pressure being made by suitable valves connecting the enclosure with the outer air; and that of Short, similar to the last. Besides these, there were several others, differing from those cited only in detail.

The Enclosed Arc in America.—In America the first attempts to utilize the enclosed arc in commerce date back to the early '80's, when Beardslee produced an enclosed arc and Wm. Baxter experimented with long-hour enclosed lamps. Baxter's experiments and tests covered a period of years, but resulted in failure. From time to time other inventors took up the subject, but as the ground covered by them differs very little from that of earlier efforts, it will not be necessary to dilate here upon the various schemes attempted since the original presentation of the Beardslee and Baxter lamps respectively. This brings us to the time when Howard took up this line of work in conjunction with me about five years ago. Most of you are familiar with the tests reported by me at the International Electrical Congress at Chicago in August, 1893. This paper was hastily prepared to present a subject which, in the opinion of those who had witnessed the trials, was deemed worthy of the fullest description possible at the time. The arrangement of parts disclosed in the lamp referred to in the paper at Chicago was rather unique in some details, but in principle did not differ essentially from earlier forms. It was thought at that time that the enclosed arc would have a large field on constant current circuits, and an attempt was made to equip existing lamps with the enclosing device. This device, which was very crude, consisted of a cylindrical glass receptacle clamped by disks which pressed tightly against its upper and lower edges respectively, the lower end being closed air-tight and the upper end provided with an opening through which the positive carbon passed. In this equipment the negative electrode was made of metal. I shall have occasion to allude to this metal negative later on; also to point out the prime cause of failure in this as well as in many of the other forms of enclosed arc herein referred to. Subsequently another device was used which consisted simply of a small bulb fitted practically air-tight at the bottom and closed on top by a valved cap through which the upper carbon fed. This appurtenance could be attached to any arc lamp. The negative electrode was in this case made of carbon. A circuit of lamps of this type was tested in the winter of 1893 and early part of 1894 at Buffalo, N. Y. The report and discussion of the tests were published in the electrical journals at the time, also in the transactions of the National Electric Light association, Washington, D. C., convention, 1894.

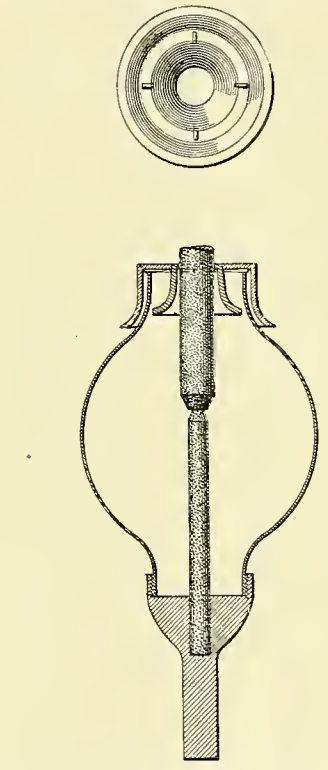


FIG. 1. THE ENCLOSED ARC LIGHT.—VENTILATED ENCLOSED ARC.

We come now to the ventilated enclosed arc, Fig. 1, which was devised by me a few years ago and described in some of your technical journals. You will note from the cut presented herewith that the enclosure is provided with means for directing the path of the ingress of air and egress of gas. You observe that the bulb is pressed tightly against a practically air-tight bottom and is closed at the upper end by a bell-shaped cap or plug, wherein resides the novelty of the equipment. This plug is made of metal and is shaped so that the rim is brought closely adjacent to the exterior wall of the envelope, thus providing a narrow annular passage for the outside air into the envelope by means of which the entering air is highly heated in transit before reaching the interior of the bulb. You will also see that the tubular opening through which the upper carbon feeds is conical in shape, the opening at the top being only a little greater than the diameter of the electrode, so as to permit a free feed of the latter and afford an obstructed egress for the gases from the envelope. As the closure touches the glass only at four points, shown in the drawing, the tendency of this arrangement is for all egress to take place by way of the central tubular opening and of ingress by way of the bell-shaped chamber. In other words, the convection currents naturally formed by the heat of the arc are taken advantage of to secure a steady and uniform circulation of oxygen-bearing gas in the enclosure. By the use of this equipment the life of the electrodes was prolonged three or four times, the lamps being operated on a constant current circuit under practically the same conditions as to current and voltage as the open arcs. In practice it was found that the ventilated enclosed arc had many shortcomings and could rarely be operated under favorable conditions on commercial circuits.

The next step in the development of the enclosed arc light gave us the method and devices which are in successful use at the present time. Before taking up this branch of the subject, I shall submit to you a short report of life tests and experimental investigations, made with the old equipment which I have already shown you. The length of cylinder used was 16½ centimeters over all, the diameter of body 7¾ centimeters, and the capacity five-eighths liter. The memoranda on effect of introducing various ingredients into the carbons and on the influence of different gases on the arc are digested from elaborate notes and observations and are given rather with the idea of recording the general results than analyzing the details of each experiment. I shall also refer to other phenomena observed in using this cylinder, especially that known as "building" of the negative electrode.

Life Tests; Cylinder with Valved Cap.—In the first of the tables given below the comparative measurements are recorded showing the life of the upper and lower carbons respectively for different sized openings in the metallic cap or plug. It will be noted that in the first test the diameter of the opening in the plug is only a shade greater than that of the upper carbon; in next to the last test the diameter is 6.35 millimeters larger than that of the carbon, while in the last test the plug is removed from the cylinder. As is very natural, the life decreases rapidly as the opening is enlarged, but, as shown in the tests, does not necessarily vary directly with the size of the opening. In each of the tests recorded the arc was started at a point slightly higher than the center of the bulb. It will also be seen that the life of the negative decreases much more rapidly than that of the positive, as the ingress of oxygen into the enclosure is increased. Thus, when the positive carbon fitted tightly in the opening in the plug,

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{2.222}{.102} = 21.78.$$

When the diameter of the opening in the plug was 6.35 millimeters larger than that of the carbon, the excess of oxygen due to enlarged opening attacked the negative vastly more than the positive, resulting in

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{2.753}{.534} = 5\ 16.$$

TABLE OF LIFE TESTS.

Cylinder with valved cap; carbons, 11.11 millimeters in diameter.

Diameter of hole in valved cap (in millimeters.)	Mean current (amperes.)	Mean arc tension (volts.)	Mean energy (watts.)	Consumption (+) carbon per hour (in millimeters.)	Consumption (−) carbon per hour (in millimeters.)
11.15	7.97	63.11	503.49	2.222	.102
11 905	7.96	62.9	500.68	1.988	.312
12.7	7.99	62.98	502.21	1.905	.424
14.287	7 99	62.8	501.77	2.328	.424
17.46	8.0	61.1	496.80	2.753	.534
28.575	7.94	62.8	498.69	11.556	8.077

TABLE OF LIFE TESTS.

Cylinder with valved cap; carbons 11.11 millimeters in diameter; mean current, eight amperes; mean arc tension, 63 volts.

Position of arc in cylinder.	Mean length (−) carbon (in millimeters.)	Consumption of (+) carbon per hour (in milli meters.	Consumption of (−) carbon per hour (in millimeters.)
Near top	158.75	2.362	.266
Between center and top	140.97	2.921	.266
At center	123.19	3.683	.393
Between center and bottom	95.25	3.073	.660
Near bottom	66.12	4.825	.965

When the plug was omitted the disparity became still greater and

$$\frac{\text{life (+)}}{\text{life (−)}} = \frac{11.556}{8.077} = 1.43.$$

In the second table I give the results of life tests in which the position of the arc was shifted from the extreme upper part to the extreme bottom of the cylinder. It will be noted that in the first test the negative was 158 75 millimeters long, while in the last it was only 66.116 millimeters long. As the arc shifts in position from the top toward the bottom of the cylinder the life of the carbons

1. Read before the Société Internationale des Electriciens at Paris, France, January 20, 1897.

decreases. This is dne to the strengthening of the convection currents as the negative burns away and consequent increase in admission of oxygen.

Influence of the surrounding atmosphere and of the constituency of the electrodes.—First—Hydrogen; introduced through a hole in the positive carbon; tests made through range of six to 11 amperes and 60 to 77 volts at the arc, voltage of he mains being practically constant and equal to 120. There was only a slight variation in the length of the arc throughout this range, the maximum length being 2.36 millimeters and the minimum 1.65 millimeters. Thus it will be seen that the presence of hydrogen tends to increase the resistance of the arc greatly, thereby shortening it to about one-sixth its normal length in carbon gas, for the same current and voltage. The arc is also unsteady, and the light cut down to a large extent. It may be noted here that when moisture has settled in the bulb or carbons of an ordinary enclosed arc, there is a tendency toward reproduction of the above conditions, the arc in such a case being very short and unsteady at start and remaining so until the moisture has been dissipated.

Second—Iodine; tincture of iodine placed in a small glass immersed in sand in bottom of cylinder. Current ranged from 5.5 to 8 amperes in different tests; voltage of arc from 70 to 75; voltage of mains 120; minimum length of arc 2.79 millimeters, maximum 3.17 millimeters. It will be noted that the action of iodine is somewhat similar to that of hydrogen, the tendency being to increase the resistance of the arc and thereby shorten the latter; the effect however is not as marked as in the last case.

Third—Chlorine; generated in the usual way and admitted to the cylinder from the bottom through a tube. Current ranged from 2.3 amperes to eight amperes; voltage of the arc from 80 to 96 volts; length of arc from 6.35 millimeters to 36.32 millimeters. It will be noted that in this case the results are entirely different than in the other two. The presence of chlorine reduced the resistance of the arc greatly, so that at 2.4 amperes and 80 volts the length was 6.35 millimeters, while at eight amperes and 96 volts the length was over 36 millimeters.

Following are some of the results with impregnated carbons:

First—Sodium carbonate ($NaCO_3$); carbons which had been soaked over night in a solution of $NaCO_3$ gave a steady arc for two hours at 8.5 amperes and 55 volts, after which for the same length of arc the voltage increased appreciably until the effect of the solution disappeared entirely. The deposit on inner wall of cylinder after two hours was thick and had a tendency to crack the glass. The ordinary foreign and American cored carbons have sodium carbonate in their cores and give similar results to the above, though less marked.

Second—Ammonium chloride (NH_4Cl); when carbons were saturated with NH_4Cl the arc was over twice as long at same voltage as in last case. NH_4Cl evaporated at a comparatively low temperature, but decreases the resistance of the arc and leaves practically no deposit in the bulb. The lower part of the cylinder became coated with condensed vapor shortly after the arc was started, but as soon as the heat became intense enough this formation was dissipated and the glass became perfectly clear. At the end of a four-hour run the extreme lower end of the cylinder was slightly coated with a yellowish green band.

Third—Magnesium oxide (MgO); $MgCO_3$ when used as a core of the negative carbon is converted by heat to MgO, CO_2 gas being driven off. The CO_2 is disassociated at a comparatively low temperature and, as may be expected, the voltage necessary for a steady arc is quite low. For 15 minutes the potential difference of the arc ranged from 40 to 45 volts with a current of eight amperes, the arc meanwhile being quite steady; the area of the crater was about eight square millimeters. The decomposition of the $MgCO_3$ was marked by a series of slight and almost inaudible explosions. Finally, a hard bead of MgO was left at the tip of the negative. This bead was extremely refractory; it did not succumb to the heat of the arc, but persisted as an incandescent globule, from which the arc stream seemed to issue. The potential difference of the arc varied from 44 to 50 volts at 8.5 amperes, the arc being quite steady for almost an hour; there was no appreciable coating on the internal surface of the cylinder. Occasionally a slight greenish hue was noticeable in the arc.

For comparative purposes different types of carbon points, all practically alike as to purity, but varying in granular structure, were tried. The following combinations were tested: First, lamp-black molded; second, lamp-black squirted; third, gas-black molded; fourth, gas-black squirted; fifth, petroleum coke molded; sixth, petroleum coke squirted. The results were practically the same for all structures of carbon.

The tabulated data show that for the same current and length of arc, the potential difference at the carbon points will depend upon the surrounding atmosphere as well as on the constituency of the electrodes. The fall of potential from one carbon to the other follows, in general, the well known law, the major portion of the drop (for short steady arc) being from the positive carbon to the arc stream. There was one experiment, however, which gave very surprising results and which is deemed worthy of mention in this connection, as the phenomena observed seemed to constitute an exception to the rule. A steel nail was driven into a hollow negative carbon as a substitute for the core. The sharp end of the nail projected just above the tip of the carbon. A solid positive carbon was used. When current was passed there were brilliant scintillations due to incandescent steel, followed by fumes which coated the internal wall of the chamber with a dark reddish deposit of FeO. A molten steel ball soon formed in the concavity at the tip of the negative. The length of the arc was between three and four millimeters, current being from eight to nine amperes and the potential difference at the arc varying from 20 to 30 volts. The negative was intensely hot, while the positive was comparatively cool. The area of the crater in the positive was about one square millimeter or about one-eighth of that in the other cases. The arc, expanded in cross-section at the negative and tapering at the positive, darted from point to point across the projecting surface of the upper carbon, sometimes jumping a distance of five or six millimeters to select a path; meanwhile the negative glowed with constant brilliancy. The arc always played from the side of the molten steel ball, the latter often spinning like a top, seemingly in unison with the arc. The results of this experiment seemed to indicate an accidental reversal of current, but subsequent tests showed that no such reversal occurred.

New Chicago Electrical Enterprise.

George W. Conover and David E. Goe, who are favorably known in the electrical business of the country, and particularly throughout the West, have formed the Conover Goe company of Chicago to deal in electrical and hardware specialties.

The gentlemen interested in this company bring to it years of experience in the electrical business, which, combined with ample capital to carry out their plans of work, would seem to promise a successful future. Although a new company in one sense of the term, the members of it are by no means new to the central stations and consumers of the United States. As will be seen, the business to be carried on is in reality an amalgamation of the interests in the western states of several different concerns under the management of Messrs. Conover and Goe. These lines of manufacturing have been successfully established for a number of years, but it is the purpose of the Conover-Goe company to greatly extend the field of operations and to increase the demand for the output of the factories interested.

George W. Conover is probably as well known to the electrical fraternity as any man engaged in the business. He was for many years the buyer for the old Electrical Supply company. His associations with this company brought him into personal contact with the leading manufacturers of electrical and hardware specialties. The acquaintances thus formed have since been added to by several years of activity in selling electrical supplies. It is a rare thing to find the qualities of a good buyer and a good seller combined in one person, but Mr. Conover's business career seems to warrant the assumption that he has the two talents strongly developed.

G. W. Conover.

D. E. Goe.

NEW CHICAGO ELECTRICAL ENTERPRISE.

D. E. Goe has been identified with electrical development, as he expresses it, ever since he was "knee high to a duck," having made an application for a patent on sundry improvements, etc., when only 13 years old. As he stands about six feet in his stockings, his experience may be said to cover a period of about 30 years. His actual work began with the unpoetical occupation of scooping out telephone post-holes under the direction of the late Wiley W. Smith. However, he soon realized that there was more plain truth than poetry in post-poles and determined to climb up; various promotions brought him to the position of state superintendent for the Southern Telephone & Telegraph company. About this time electric lighting was claiming a large share of energetic talent, and Mr. Goe became engaged in the installation of isolated plants. The fund of practical experience gained in this occupation has been of invaluable service. In 1890 he made the acquaintance of F. S. Terry and was asked to assume the duties of advertising manager for the Electrical Supply company. To this work he applied himself with a zeal that smacked of dormant newspaper acumen, and station men were taught through the advertising columns of the trade press that the Electrical Supply company was by all odds the biggest thing on deck, and they also discovered that there was a real funny as well as a serious side to the station man's daily toil. Almost everyone will remember the *Electric Spark*, which was published in the interests of the Electrical Supply company, as they have either laughed or cried over Mr. Goe's mirthful vagaries. For the last two years he has been manager for the Central Electric company and has also directed the advertising work for that concern.

The Conover-Goe company has contracted for the entire output of electrical and hardware specialties manufactured by the C. H. Dickey Tool company. Other lines controlled in western states are made by the Paragon Arc Lamp company of Boston, Mass.; the line of Hartford switches made by the Gibbs Electric & Manufacturing company of Hartford, Conn.; porcelain specialties, rubber goods and insulated wire made by C. S. Knowles of Boston, Mass. Other important deals are about to be consummated and there is no doubt that the affairs of the Conover-Goe company will at once assume a gratifying and profitable proportion. The many friends of the gentlemen interested will wish them all possible success.

Presentation to Thomas R. Mercein.

Just before the Milwaukee meeting of the Northwestern Electrical association a few of the associate members from Chicago happened to be discussing the good work of the secretary of the association, Thomas R. Mercein, when the happy suggestion was made that, as a token of his friends' appreciation and the great esteem

PRESENTATION TO THOMAS R. MERCEIN.—BADGE FROM CHICAGO MEMBERS OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

in which he was held by those in a position to understand the value of his services to the association, a remembrance be presented to Mr. Mercein during the Milwaukee convention. The suggestion was received with instant approval, and the idea was quickly followed up by a number of Chicago's prominent electrical representatives, a subscription started, and the outcome was the presentation to Mr. Mercein of the very handsome Northwestern Electrical association badge illustrated herewith. In this design, however, a diamond takes the place of the small incandescent lamp.

James Wolff of Chicago was chosen spokesman for the occasion, and at the convention banquet in Milwaukee Mr. Wolff handed the badge to Mr. Mercein. The trinket, though small, to quote Mr. Wolff, came "laden with the best wishes for Mr. Mercein's happiness and future prosperity from all of the associate members of the Northwestern Electrical association."

It was quite evident from Mr. Mercein's surprise that the secret had been well kept. His response was happy and appropriate.

Notable Factory Transmission Plant at North Tonawanda.

Although the transmission of power outside the limits of Niagara Falls is not yet a month old, a large nut and bolt works at North Tonawanda has been waiting fully equipped for the appearance of the current for a year. These works, the largest nut and bolt factory in the country, are those of Plumb, Burdict & Bernard. At the time the electrical equipment was under consideration, the question of utilizing Niagara power naturally arose, and it speaks well for the foresight of the owners of the works and the equipping company, the General Electric company, that the three-phase system was selected instead of the two-phase. The three-phase system having been chosen by the Niagara Falls Power company for the transmission of power from Niagara Falls to Tonawanda and Buffalo, the bolt and nut works can be operated directly from the transmission line by simply connecting the necessary static transformers.

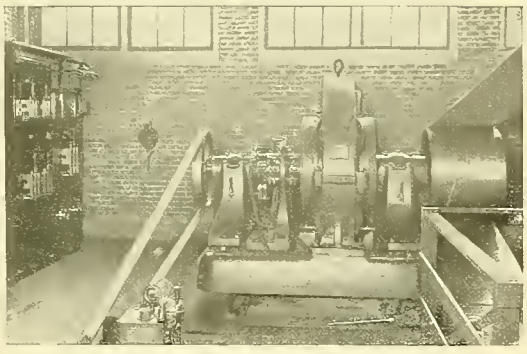


Fig 1. Three-phase central station.

Fig. 2. One corner of the machine shop, showing 20 horse power induction motor.

The factory of Plumb, Burdict & Bernard is situated at North Tonawanda, directly on the lines of the New York Central and Erie railroads, and about half a mile from the route taken by the overhead wires of the Niagara-Buffalo transmission plant. It is divided into three single-story brick shops, running north and south, the forge being nearest the railroad, the cold shop, engine room and machine shop lying in the center, and the threading and finishing shops on the side nearest the transmission line. All the work, with the exception of the cold work, starts at the forge shop and passes on through the various operations until it leaves the finishing shop ready for the market. There is no waste of labor and time passing material from different points in the shops. The progress is methodical, each succeeding operation being set next to the previous one.

Until Niagara power can be obtained, the works are being operated from their own generating station, which will be abandoned as soon as the Niagara Power company is ready to tap the three-phase lines into the factory. The generating station is set between the cold and machine shops in the central building. Steam from the engine is supplied by three Riter Brothers return tubular boilers, each of 100 horse power capacity. The engine is an improved Green of 400 horse power, belted to a General Electric company three-phase six pole 150 kilowatt 25 cycle generator. The exciter is a three kilowatt 125 volt bipolar machine. The switchboard is of panel type, built up of two panels, one for the generator, the other for the feeders. The generator panel carries potential indicator, two current indicators, field switch, main switch and two Carpenter enamel rheostats. The feeder board in addition to the fuses is equipped with four three-blade knife switches, each controlling one circuit and labeled "Cold Press," "Machine Shop," "Thread Shop," "Forge Shop," respectively.

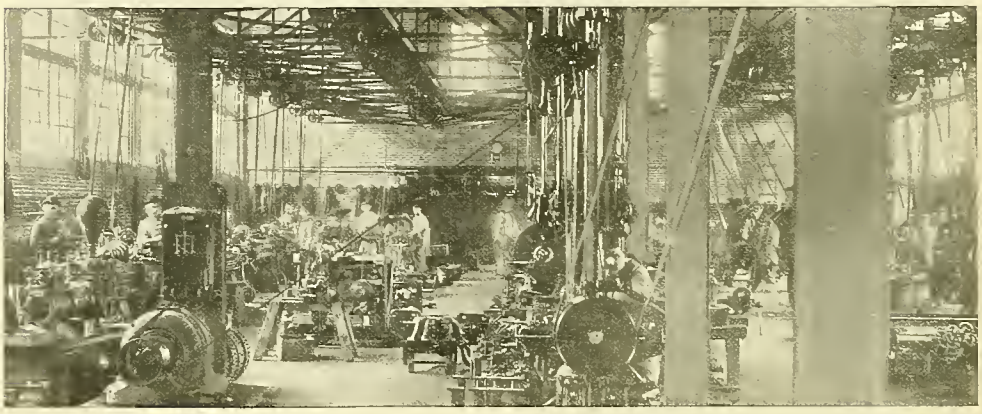


FIG. 3, NOTABLE FACTORY TRANSMISSION PLANT AT NORTH TONAWANDA.—20 HORSE POWER INDUCTION MOTOR DRIVING TOOL MAKING AND OTHER MACHINERY.

The forge shop, where the nuts and bolts are cut off from the raw rods and bars, is about 360 feet long, having the forges and machines set down each side of a central aisle, along which a track is laid. Above the machines on each side runs a line of shafting, and in arranging the line of shafting the firm has adopted a very simple method. Suspended from the roof girders down each side are four lines of channel iron in two sets, each set bolted back to back. Each line is separated from the other about 20 inches. Through the space between each pair of channels, pass long bolts which support the hangers for the shafting and allow of a ready rearrangement at any time. This method is adopted throughout the shop. The forge shop contains five 20 horse power General Electric induction motors, four driving the shafting and one operating a blower. The shafting is divided into four sections, and each one is belted to one of the induction motors. The driving motors themselves are set upon a platform above the shafting in the center of the shop, and are boxed in. The blower motor, directly connected to the blower, occupies a platform at the south end of the shop. The machines driven by the motors in the forge shop are different sizes of bolt headers and nut punchers and shearing machines for shearing the bolt lengths from the rod.

In the cold shop the pointing department is operated by one 20 horse power motor, set on the floor and belted to jack-shafts and counter-shafts as necessary. In the machine shop, lying on the south side of the engine room, is another 20 horse power motor, also set upon the floor. It is used to drive a variety of tool-making machinery, such as planers, milling machines, drills, slotters, shapers, etc. The threading and finishing shop, 400 feet long, is next in length to the cold shop which is 430 feet in length. In it the bolts and nuts traveling from the other shops are threaded and tapped and put together ready for the market. This threading and tapping of the smaller pieces is effected automatically for some and semi-automatically for others, and in all cases the operations involve some of the prettiest automatic and semi-automatic work to delight the eye of the mechanic. The automatic nutters which put the nuts upon the bolts are marvelous in their accuracy and speed. This shop is driven by six six-horse power motors set on small platforms and three 20 horse power motors. The smaller motors and one 20 horse

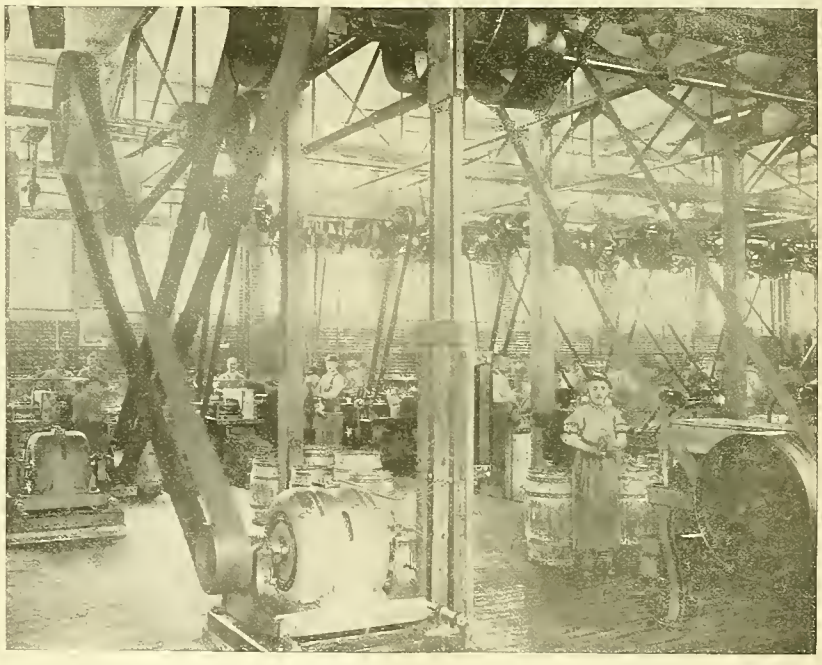


Fig. 4. Two 20 horse power induction motors in the threading and finishing shop

NOTABLE FACTORY TRANSMISSION PLANT AT NORTH TONAWANDA.

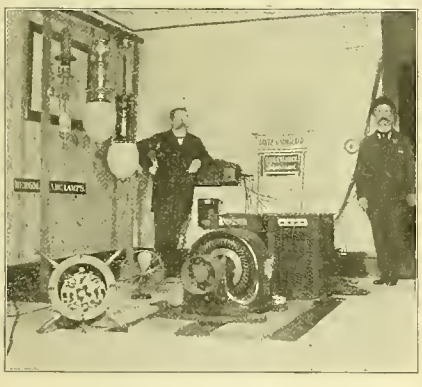
power motor are used to drive the automatic and semi-automatic machines. For the former they are belted to jack-shafts, from which belts are dropped to pulleys on a shaft running underneath the machinery. For the semi-automatic machinery, the pulley is on the level of the machines and is belted to the jack-shaft above. The other 20 horse power motors are set on the floor and are belted to shaftiog on the opposite sides of the shop, as shown in the illustration. These serve to drive the heavy threading and tapping work not automatic, and some idea of the variety of machinery in these shops, and the work the motors are called upon to do, may be gathered from the fact that the sizes of bolts made run from three-sixteenths inch up to 1½ inches.

The advantages of electric drive are markedly noticeable in this plant. There are no separate engines for the individual shops and no belt holes in the walls, as would have been the case had the steam driving plant been confined to an outside building. The wires come through three small porcelain-bushed holes in the wall of each shop. The central steam and generating station is confined to one room at present, and will probably shortly be entirely abolished. The motors in the forge shop occupy no space on the floor of the shop, and those in the other shops occupy either small space upon the floor or are erected on small platforms. They require no attention beyond the filling of oil wells, which is performed but once in six months. They are started by the throwing of a switch, and maintain a steady and constant speed under all conditions of load. This is noticeable in the quality of the output.

Cloos Junction Box.

With the advent of the high-tension alternating current underground system, there has been made apparent the necessity of an improved method of making connections to the feeders in the manholes. While the method of wiped joints gave good satisfaction and high insulation when well done, it made the testing for insulation almost impossible, except upon a whole system connected to each feeder. When the insulation was low on a feeder, the location of the fault necessitated the cutting of a number of joints in order to divide the cable into sections; this, together with the time consumed in renewing the joints, caused the whole section fed by that feeder to be in darkness for a considerable time. It was evident that some method was required by which a permanent and high-insulated connection could be made, and at the same time allow easy access to the ends of the cables for cutting out and testing.

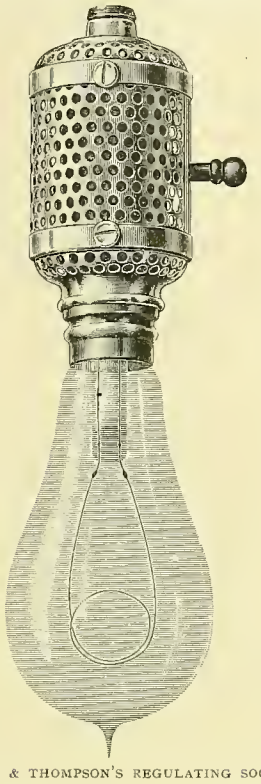
This difficulty has been met, and that in a very successful manner, by Jacob Cloos, electrical engineer for the Pabst Heat & Light Power company of Milwaukee, Wis , by a junction box, which has been in operation



CLOOS JUNCTION BOX.

for some time on a 2,400 volt underground system at the above company's plant. This device (shown in the accompanying illustration) consists of a cast-iron box of cylindrical section. The top of the box is made watertight by means of a lead gasket and holding-down screws. The feeder and mains are led into the box through brass bushings, screwed in with a lead gasket. The lead cover of the cable is joined in the bushing with a wiped joint. Within the box are two marble plates about three inches apart. Upon the top plate are mounted brass terminals arranged in three concentric rows for three-wire cables connected by special terminals and buses to the various cables. Upon the lower plate are three continuous brass rings directly under the brass terminals on the upper plates. The lower rings are made "alive" by pushing spring plugs through holes in the terminals connected to the feeder into holes in the rings directly below on the lower plate. Any leading-out cable may be connected to the feeder by similar plugs leading from the rings to the cable terminals below. The boxes are filled with oil, thus forming a water-proof joint of high insulation and one easily accessible. These boxes have been in use when covered with water and no difficulty has been experienced. They have demonstrated their great value on several occasions by enabling repairs to be made, faults to be located on sections, without interfering in any manner with the operation of the rest of the system.

The necessity for something of this kind on a high tension and complicated system, such as has become common of late years, has become very apparent in both underground and overhead systems, and it is the intention to adapt these boxes in various forms for both uses.



BRUNT & THOMPSON'S REGULATING SOCKET.

This box will be handled by Donley & Bunce, 1141 Monadnock Building, Chicago.

Brunt & Thompson's Regulating Socket.

This new regulating socket is guaranteed to produce the desired result in dimming the light of an incandescent lamp if used as directed. It is made by Brunt & Thompson of East Liverpool, O., whose western office is at 231 Wabash avenue. The sockets are designed for 110 volt 16 candle power lamps, direct or alternating current. The manufacturers state that the Western Electric company and Chicago Edison company have tested the socket and found that it saved 40 per cent. of the current when "turned down." In testing the device Brunt & Thompson operated a 16 candle power lamp for 300 hours that was turned down to two candle power by use of the regulating socket. This lamp is still burning, and the fact seems to indicate the durability of the socket. The socket is recommended for sleeping and sick rooms, hotels, closets and any place where a "turned down" light is at times necessary.

New Joist-boring Machine.

One of the greatest difficulties which exist at the present time in the wiring of buildings, and one which causes the wiremen trouble untold, in addition to a considerable loss of time, is the boring of overhead timbers and joists for the passage of wires. This trouble and loss of time is frequently so great as to increase the cost of installation by an appreciable percentage. An overhead joist-boring machine that is handled by the Metropolitan Electric company of Chicago seems to meet this need. The illustration shows the manner of application. This machine will, it is said, do about three times the amount of work a man can do without it, when he uses the ordinary angle brace, such as is customary with such work. At this rate a machine should pay for itself within two or three weeks' time very easily. This tool bores a hole of any size, and straight through the joist, thus greatly facilitating the stringing of wires, as when the hole is straight it does not necessitate the bend of the wire at each joist, and also prevents the liability of insulating tubes dropping out of the holes, as they frequently do when the holes are bored at an angle. The machine is also so constructed that it can be quickly adjusted to any width of space between the joists and it allows the operator to stand in an easy, upright position, and does not require him to reach up over his head when using the machine. The bit, which is rigidly held in the chuck, can be easily removed when desired and a different-sized bit inserted. The whole machine is substantially built for work, and there is nothing to get out of order about it. It is one that thoroughly commends itself to a workman.

NEW JOIST-BORING MACHINE.

Municipal Ownership.

[*Continued from page 77.*]

tion is made for this committee and the committee gives this information necessary to maintain our position, then let this association appropriate money enough to send a man to Madison. It is not going to cost very much. You will find when you get there that the Wisconsin legislators as a rule are very fair-minded, good fellows, if they understand the proposition rightly and our representative puts it before them in the right shape. We can have legislation that will protect the central station owner. We can have a duplicate of the enactment of the Massachusetts Legislature regarding the purchase of the local plant by the municipality.

MR. COLMAN: The fact is this business itself is responsible for the distrust that has come upon it among the people, because the installation of some of the plants through this country has been most stupendously fraudulent, and some of the companies have been responsible for it. I know of those things to my own personal knowledge, as an attorney, and I can tell you of a plant where not more than $50,000 was invested, and the plant was bonded for $400,000, stocked for $400,000, and notes issued for another $100,000.

H. F. PEARCE, Negaunee, Mich.: About a year ago Mr. Pingree made a visit to the upper peninsula and came to Negaunee. Mr. Kirkwood, who is mayor of Negaunee at the present time, is a great admirer of Pingree, and thought by following out Pingree's Detroit example in Negaunee money would be saved for the city. He engaged Mr. Rae to give an estimate of what it would cost to operate 30 street lights and 1,000 incandescent lights. The figures given were somewhat like a fairy tale; the city was to run 30 street lights on a dark night schedule and 1,000 incandescent lamps (that is what they would use regularly) on less than 300 tons of coal per year. It was thought that by putting in this plant right away, that is, providing it could be put in for less than $10,000, the city would go ahead. Mr. Rae's figures pointed out where the city could make 60 per cent. profit on the plant. At a meeting the subject was discussed and the conclusion reached that the city should advertise for bids. Three or four bids were received from the Fort Wayne, the Westinghouse and the Western Electric companies. There was only one bid-

der for the engines, the Russell company. The contract was let by three hostile aldermen with whom we had had difficulties. They were the members of the electric light commission and they let the contract to the Fort Wayne company through Mr. Rae's suggestion.

They went to work in such a way that the people throughout the town were somewhat disgusted with their operations, and there was an injunction got out on the ground that they were spending money without the consent of the taxpayers of the town. The injunction was made permanent and an election was required. Everybody can vote on a proposition of that kind—that is, all the voters—the law does not specify taxpayers or anything of that sort, and, by the way, in the council at the present time there are only two taxpayers. After the election was over we found out that we had lost.

MR. BEAN: You did not "cultivate" the councilmen, evidently.

MR. PEARCE: Evidently not. After the election was over we proposed to bid on the plant ourselves, and the General Electric company said they would bid. We thought that if the municipality was determined to put in this plant we ought to have some recognition; that is, that they should buy our machinery, as we would have a fair plant lying idle. There was a meeting of the council after that in which they decided to readvertise for bids. In the second asking for bids there were four bidders—ourselves, the street railway company, the Fort Wayne company and the General Electric company. We bid on a complete plant. The Fort Wayne company bid on the electric apparatus and the Russell Engine company bid on the engine, and they were somewhat combined, I guess. The General Electric company bid on the electric apparatus alone. Our bid was $2,000 lower than the Fort Wayne's—that is, the complete bid. The General Electric company was about $250 lower than the Fort Wayne bid for electric apparatus. There was an executive session held in which Mr. Rae was asked to take part. When they came down everything was let to the Fort Wayne company the same as usual, that corporation being the highest bidder.

After these bids were let another injunction was gotten out on the grounds of fraud, illegal election and that the outlying lands were not properly taxable for the purposes of municipal electric lighting. The case was tried at the Circuit Court and the injunction was dissolved, but the matter has been appealed to the Supreme Court, and only a few days ago the Supreme Court granted a stay of proceedings, which really means another injunction from the Supreme Court. The point is that the outlying lands are not taxable for the purposes. The plans are drawn up, the lights are located and the city of Negaunee, in order to raise taxes enough for the support of the city government, is obliged to annex more property to the city. Some of this property is at least two miles from the city; and these people object to paying the tax for electric light purposes. So that is the way the matter stands at the present time. A few days ago some of the Fort Wayne machinery arrived. There were a few 30 foot poles, I think about six or seven, and the rest of them were 15 foot poles. The plans and specifications call for 35 foot poles, while we have put in in our plant 40, 45 and 50 foot poles. On the way up the Fort Wayne representative was given a note by Mr. Rae, asking the City Council to pay over to the Fort Wayne company half of the contract price, which was $3,250; that everything was O. K.; and it was signed by the engineer. The City Council refused to pay.

JOHN SCHUETTE of Manitowoc, Wis.: When times are stagnant, when everything seems to go wrong and when the people's minds are not fully occupied in their own business, all kinds of new theories are advanced for the betterment of the condition of the human race. Especially do we find those most active who have not by their own effort and ability managed successfully their own business and could not keep pace with their neighbors. They attribute their failure to the wrong social and economic condition of things. Knowing that it is easier to swim with than against the current of public opinion, they survey the stream, and soon discover that it is surging with a great roar against corporations, so they plunge into the swim.

Now they get down to work, compiling estimates of the cost of different plants, figuring out the operating expenses, and having no practical knowledge of these affairs get somewhere below 50 per cent. of the actual truth. Then these false conclusions are disclosed to the public, showing apparently that the corporations are robbing the people, and an array of figures, which never lie, are presented, showing how much the consumer could save if the city owned and operated its own plant. As their figures are seldom contradicted by the corporations, for the reason that if honestly presented they would not be believed, it is most natural that all such erroneous accusations against corporations are accepted as well founded, and so it follows that the agitation for municipal ownership goes merrily on.

From an extended experience in the electric lighting enterprise, I am satisfied in my mind that if this branch had been owned and operated by municipalities from the time the first light was installed to the present day, it would have been on an average far more expensive to the inhabitant than it has been. There is hardly a franchise granted at the present time without limiting the charges for service rendered, and as long as such charges are reasonable, as long as the earnings are no more than other unlicensed enterprises, municipal ownership will not be advantageous, but detrimental to the public welfare.

In case there should exist plants which owing to loose franchises should abuse their powers, it might be well to have a law, such as already exists in some states, by which a reasonable charge could be determined and regulated.

The most serious objection to municipal ownership I find lies in the increased opportunities and temptations offered for boodling, and the multiplied power to form and maintain rings. Supposing we add to the regular city officials and employes all those of water works, gas works, electric light plants, telephones, telegraph, railroads, and then add, as some advocate, the saloon interest, which are also licensed institutions, why these combined forces, having abundant spare time while under public pay, can and would electioneer every day in the year. This active self-interested element would exert such a political influence in our caucuses and elections that our citizens, other than the office class, would be practically disfranchised.

The little interest taken in our caucuses and elections by our business men is attributed to the active selfish political rings, against which a disorganized force is powerless, and the result is bad city government. How much more would these evils be intensified if these rings were multiplied and unified?

Westinghouse Company Demands Royalty on Lamp Filament Patent.

The *New York Tribune* of January 31st contained this interesting statement:

Some months ago there was an exchange of patents between the Westinghouse and the General Electric companies, by which the former obtained control of the patents covering the use of cellulose filaments in sealed glass globes for electric lighting, and covering the treatment of other filaments in use. As a result of the exchange of interests the Westinghouse company has issued licenses to other companies, upon contracts, by which the companies are bound to pay royalties for the use of the patents in the manufacture of incandescent electric light lamps.

About 90 per cent. of the lamps manufactured are turned out by ten companies, but there are some thirty smaller concerns which went into the business after the Edison patent on the filament expired, and some of them have supposed that there was no patent in existence which prevented them from carrying on the manufacture without trouble. Some of them have not yet agreed to pay the royalties demanded. Representatives of the Westinghouse company have denied the report that the contracts with other companies prevented any cutting in the prices of the electric lamps or globes. The price has been as low as 17 cents a lamp, but the lamps now sell at 20 cents, ordinary size. The attorney of the Westinghouse company yesterday made the following statement to a *Tribune* reporter:

"The Edison patent, which was sustained by the courts and was claimed to cover broadly the incandescent lamp, expired two or three years ago. The Sawyer-Man patent, for which a similar claim was made, was declared invalid by the courts. These were the two most important patents affecting the incandescent lamp industry, and the litigation regarding incandescent lamp patents was until lately mainly confined to these two patents.

"The Westinghouse company owns a considerable number of patents covering various features of incandescent lamps, and also processes and apparatus used in the manufacture of incandescent lamps. One of these patents covers cellulose filaments, which are now very widely used. Another covers the treatment of fibrous filaments, and others cover other important and in some respect essential features of the incandescent lamp.

"Now that the lamp litigation, which formerly absorbed so much money and attention, is at an end, the Westinghouse company is in a position to give attention to the enforcement of its other patents. It, however, has pursued the policy of granting to other lamp manufacturers licenses under these patents at moderate rates, and most of the principal lamp companies have taken such licenses and are now paying a moderate royalty to the Westinghouse company. There of course can be no litigation regarding these patents with the holders of licenses, but the patents will have to be enforced by suits against such manufacturers as do not hold licenses."

New Equipment for the Armour Institute of Technology.

A valuable increase in equipment has been recently made at Armour Institute. The electrical engineering department has remodeled its generating plant. A handsome marble switchboard has replaced a board constructed on the older lines. There are three panels to this board—an alternating current panel, one for direct current dynamos and power distribution, and the third for the lighting circuits. It was designed and constructed by the department.

A dynamo of considerable capacity—100 kilowatts—has been installed. It was built by the Western Electric company, and is of the six-pole 110 volt type. A new engine is also being set. It is a Russell automatic engine 11½ by 14 inches and 260 revolutions per minute. This engine will be belted to a 50 kilowatt dynamo and will be run for light loads and furnishing power for special tests. The mechanical engineering department is at the same time placing a small cross-compound engine for testing and valve setting. Its equipment has also been increased by a 13 horse power gas engine, made by Fairbanks, Morse & Co. Its general laboratory equipment is also being extended.

Two additional electrical laboratories are being fitted up. One is a dynamo laboratory; the other is for ballistic galvanometer work and insulation testing.

The Proposed Consolidation.

Nothing definite has been done in the negotiations between the Siemens & Halske Electric company and the Fort Wayne Electric corporation, although there is no reason to believe that the matter has been dropped, but on the other hand it is said to be progressing favorably. At the Siemens & Halske meeting last week the matter was not considered; in fact the meeting had been called for another purpose, and the question could not legally be acted upon at that time.

CORRESPONDENCE.

New York Notes.

NEW YORK, January 30.—It is now announced that the contracts have been signed for the equipment of the Fourth, Sixth and Eighth avenue lines of the Metropolitan Street Railway company with the Genera Electric company's trolley conduit system such as has been tried in Lenox avenue. It is said that 250 cars are to be electrically equipped at a cost of $200,000 and that the work of building the conduit will be begun as soon as the weather permits. The Fourth and Madison avenue line is to be equipped first, and it is expected to be in operation in three months. Current will be supplied from the cable power house at Twenty-fifth street and Lexington avenue. When the Sixth avenue line is changed to electricity the generating plant will be installed in the company's building at Fiftieth street and Seventh avenue. For the Eighth avenue line possibly another station will be built. This contract marks the first entry of electric traction into the city of New York on a large scale. It is also the first commercial employment of the trolley conduit system in a crowded city like New York. The construction and operation of the new lines will be watched with much interest.

The Second Avenue Railroad company has been practically absorbed by the Metropolitan company. The Second Avenue company is capitalized at $3,762,000, of which $1,862,000 is of capital stock (authorized issue of $2,500,000), $1,600,000 general consolidated first mortgage five per cent. bonds due November 1, 1909, and $300,000 debenture five per cent. bonds due January 1, 1909. There is also a mortgage of $60,000 at five per cent. on the company's stable property, which is past due and can be paid at any time. For the last five years the line has carried about 19,000,000 passengers annually. In 1895 its gross receipts were $957,465, operating expenses and taxes $766,441, net income $191,024, out of which it paid $97,903 interest and $93,100 dividends at five per cent. and had a surplus of $21. It is operated by 1,932 horses and owns 356 cars. It is said to be certain that once under the control of the Metropolitan the horse traction will be done away with on the Avenue lines, and for it the underground trolley will be substituted.

An announcement sad to those who honor the name of Cyrus Field has just been made. It is that within a few days what pitiful remnants are left of the great Cyrus W. Field fortune will be sold under the hammer by order of Mrs. Cyrus Field, Jr., who is going to Europe six weeks hence for a long stay. The Field curios will not amount in real value to over $20,000, if they will that. All the rich gold medals and foreign decorations presented to the projector of the Atlantic cable are in the Museum of Art. Mrs. Field will not describe at this time the treasures she has decided to turn into cash, but the sale of whatever there is left will be a final distribution. Mrs. Field has been running a modest millinery shop in Fifth avenue for several years.

The grand jury has indicted the Metropolitan Traction company and the Metropolitan Street Railway company for maintaining a public nuisance. The public nuisance is the propelling of cars at speed on the Broadway cable curve at Fourteenth street, known as Dead Man's Curve. The charge under the indictment is a misdemeanor, and the corporations, if convicted can only be fined $500. But in case it is shown later that the officials of the corporations give orders to continue the nuisance, they may be individually indicted and arrested. Counsel for the railroad company will be notified to appear in the Court of General Sessions on Monday to plead to the indictment. M. S.

Northwestern Notations.

MINNEAPOLIS, January 30.—The city of Mankato, Minn., is taking bids until February 6th for furnishing an electric lighting plant with 60 to 75 arc lights of 2,000 candle power. The bonds for this plant were voted two years ago, but the first bids exceeded the appropriation, and then an injunction suit was begun, which is still pending in the courts.

The electric light bond issue of $8,000 voted by Beatrice, Neb., has been held illegal.

Creditors of the street railway company of Stillwater, Minn., have been trying to arrive at some satisfactory understanding for the sale of the plant. As expenses are piling up daily, some of the creditors wanted the plant sold without the expense of readvertising, but some of the largest creditors refused to go into the arrangement.

The city of Negaunee, Mich., has been enjoined from proceeding to construct an electric lighting plant, the writ being returnable February 2d, when the city is ordered to show cause why the injunction should not be made permanent.

The mayor and light committee of Des Moines, Iowa, have accepted the plans of Frank B. Rae, engineer, of Chicago, for a municipal electric lighting plant.

An incandescent electric lighting system is promised for Centerville, Ia.

Robert Jefferson, who has charge of the engine room of the electric light plant at Aitkin, Minn., had a peculiar experience. He thought he heard an unusual noise from the machinery and bent over it to listen when he was taken with a dizzy fit and started to fall. While falling he was struck a powerful blow on the head by one of the governor balls and thrown to the floor in a semi-conscious state, but before falling he was able to draw the plug switch connecting the dynamo with the circuit leading to the city. This threw the city into darkness and the superintendent of the plant hurried to ascertain the trouble and found young Jefferson and took him to his room. C.

PERSONAL.

L. E. Frorup, of Schiff, Jordan & Co., New York, is making a western trip. He stopped in Chicago last week, where he has many warm friends.

Armour Institute of Technology has a student from Japan, George Hanai, who was formerly in charge of the government telegraph of several canton. He is taking a course in the electrical department under Prof. Stine.

E. Ward Wilkins of the Partrick & Carter company, Philadelphia, was a welcome caller at the office of the WESTERN ELECTRICIAN last week. Mr. Wilkins, as already announced in these columns, is on an extended trip to the Pacific coast.

The Among the electrical visitors and attendants seen at the Chicago cycle show last week were A. A. Thresher of Dayton, O.; H. P. Andrae of Milwaukee; B. J. Arnold, Harry Osburn, George S. Searing, M. B. Bailey, C. P. Lee, L. W. Collins, W. R. Goodman, George L. Beetle, C. D. Wilkinson, L. T. Milnor, M. L. Scobey and Jesse Scribner of Chicago.

At the annual meeting of the Franklin Institute in Philadelphia last month the following-named officers were elected: President, John Birkinbine; vice-president, W. P. Tatham; secretary, William H. Wahl; treasurer, Samuel Sartain; auditor, W. O. Griggs; managers, John H. Cooper, Arthur Beardsley, Henry C. Brolasky, James Christie, F. L. Garrison, H. W. Jayne, Lawrence T. Paul, Horace Pettit; committee on science and the arts, Wm. M. Barr, H. F. Colvin, Thomas P. Conard, Spencer Fullerton, John M. Hartman, John Haug, Wm. C. Head, Wm. C. Henderson, H. R. Heyl, Geo. A. Hoadley, Louis E. Levy, D. A. Partridge, Tinius Olsen, Samuel P. Sadtler, Paul A. Winand.

The announcement of the death of Lewis H. Hart has come as a great shock to many friends in the electrical business. Mr. Hart passed away at his residence, No. 11 Montague terrace, Brooklyn, on January 25th, after only three days' illness. He was well known in electrical circles. He was one of the old telegraphers in Connecticut, where he first got a start in his business career; from this he accepted a position as traveling passenger agent for the New York, New Haven & Hartford Railroad company. During the time that he was acting in this capacity he was elected to the Connecticut Legislature, where he served one term with credit. Being offered the position of New England manager of the *Electrical World* at Boston, he accepted, and proved himself to be so efficient that he was called to New York to take charge of the business office of that journal. This place he held until 1893, when he established *Heating and Ventilation*, a journal which was successful from the start. Mr. Hart was also the first one to suggest the organization of the American Society of Heating and Ventilating Engineers, and was preparing for the annual meeting when he died. Mr. Hart had a happy faculty of making friends and retaining their confidence. His death is sincerely regretted.

ELECTRIC LIGHTING.

The Demopolis (Ala.) Electric Light & Power company has been organized, with F. E. Semon general manager. The capital stock is $7,000, and a 25 arc and 600 light incandescent (alternating) plant will be installed.

Shortly after noon on January 25th the Economy Electric Light & Power company's plant in Joliet, Ill., was discovered to be ablaze, and the main portion of the plant was destroyed, with $100,000 loss. It was insured for $49,000. The fire started from an explosion of a small oil stove used in the basement to keep the pumps from freezing. The steam and smoke did not alarm the employes until the entire building was in flames, and workmen had no time to secure their clothing. Arrangements were made to light street lamps from the street car power house, while stores and public buildings were supplied from the penitentiary plant.

ELECTRIC RAILWAYS.

The Calumet Electric Street Railway company of Chicago has been reorganized so as to give the present management of the National Bank of Illinois the majority of the board of directors. F. W. Leach, H. B. White, Carl Moll and Robert Berger resigned from the directory, and John C. McKeon, George E. Adams, George C. Prussing, and James R. Mann took their places. John Farson was continued as president and H. M. Sloan as general manager. The policy of the road will not be changed, it is said, and this is believed to indicate that hope of an immediate sale has been abandoned.

The elevated structure for the Union Loop in Chicago, to be equipped for electric railway operation as recently described in the WESTERN ELECTRICIAN, is now completed, so far as the heavy iron work is concerned. It is stated that at every third span, first on one side and then on the other, so that the two would not come opposite each other, no riveting is done. The girders were simply hoisted and lowered into positions in "shoes." These open connections are known as "slip" joints, and are left to accommodate the contraction and expansion of the iron which takes place in cold and hot weather. The theory is that if all the sections were tied together with rivets there would be a snapping and pulling apart in cold weather, while if the structure was subjected to hot weather, it would either rise up or bulge out on the side, in either of which contingencies the whole structure would be thrown out of line.

MISCELLANEOUS.

In following out its plan of giving its pupils the advantage of the experience of men engaged in the several branches of the electrical business, the Chicago School of Electricity has furnished an admirable series of practical talks, the latest of which is by James Wolff, on the "Manufacture of Insulated Wire."

Lord Kelvin, referring to Edward P. Thompson's book on Röntgen rays, writes: "I received it only a few days ago, but I have already looked nearly all through it, with great interest. I have seen enough to know that I shall find much most useful information in it which will always be readily available, because of the very excellent method and care with which you have given reference to authors, dates and publications, and I am sure that all who are interested in the subject will find your book exceedingly valuable. All your statements with reference to anything I have done on the subject are perfectly correct. I believe that hitherto nothing in the way of diffraction has been discovered for the Röntgen rays."

TRADE NEWS.

The Metropolitan Electric company of Chicago reports that its property was only slightly damaged by the large fire which occurred in the adjoining building last week, as the fire did not reach its stock, and what little damage it received was from water and not sufficient to prevent the continuance of business.

George A. McKinlock, president of the Central Electric company of Chicago, has lately returned from an eastern trip. He spent some time in New York, and, in company with George T. Manson, general superintendent of the Okonite company, he made a number of calls on electrical friends in and about Boston.

The American Electric Heating corporation of Boston has issued a complete revised price-list in condensed form, yet completely describing the company's improved products. Many improvements have been made in the last year and new items added, while prices have been reduced. Dealers should get the new list and new discounts.

The Manhattan enclosed arc lamps are away up among the stars in the picture on the Manhattan General Construction company's '97 calendar. They are supported by two nude female figures, who, gracefully poised in space, are represented as dispelling the blackness of the night by the brightness of the illumination afforded by their lamps. J. H. Cooke is western manager for this company. His office is at 753 Monadnock building, Chicago.

The popularity of Okonite wire still continues, and the longer it is identified with the electrical business the more of a necessity it becomes. Superintendent Frank Mason of the police and fire-alarm department of Brooklyn gives one of the strongest testimonials as to the high standard of this well-known wire in a recent interview. As he has used large quantities of Okonite cables, which have stood up under the most severe conditions, he is in a position to judge.

The new booklet of the Buckeye Electric company of Cleveland is a tasteful publication, and it shows up the various types of incandescent lamps made by this company very well indeed. The company has a well deserved reputation for the excellence of its product, and it now ranks second, it says, among the world's manufacturers of incandescent lamps. It was the first, it is claimed to introduce the cellulose filament. J. H. Cooke, 753 Monadnock building, Chicago, is the general distributing agent.

The Missouri Telephone Manufacturing company, St. Louis, Mo., is pushing ahead. It has secured the second floor of the building at 917-919 Market street, giving it double capacity. It is equipping its factory with all the latest improved machinery. Its new catalogue is now off the press and is claimed to be the largest and most complete telephone catalogue ever issued, containing additional information as well as illustrating and quoting prices on its complete line of goods. This catalogue will be sent free upon application.

The best evidence of the superiority of any article is the testimony of those who have used it. The universal opinion of those who have handled the flexible conduit of the American Circular Loom company is favorable. Owners of buildings, architects and contractors join electrical experts in pronouncing it one of the great advances of the age in interior electrical construction work. The recent catalogue of this company gives a list of the principal buildings in which this tubing has been used and the opinions of the leading architects and electrical engineers of the country on this subject. An idea of the character of the work done is shown in the illustrations of buildings equipped with this conduit. It is worthy of note that the Chicago representative, A. D. Chandler, makes a splendid showing in this list.

The little book on "H. W. J." electric heaters, just issued by the H. W. Johns Manufacturing company of 87 Maiden Lane, New York, is neat, compact and well arranged, containing much information in small space. Especial attention is paid to the car heating system, and especial stress is laid on the equal distribution of heat throughout the car. A large amount of radiating surface is furnished by the heaters, and as many of them as possible are placed in a car in order to obtain this large amount of surface. The result is very noticeable in the heating of a car. The sensation on entering a car is frequently different from that experienced when entering a car heated with half the number of heaters, which are necessarily obliged to operate at two or more times the activity per heater. In the case of the "H. W. J." heaters the car is uniformly heated throughout at a gentle temperature, the heaters themselves remaining comparatively cool. Tests have shown that the heated resistance wire also attains a comparatively low working temperature. This fact is again the result of the greatly increased radiating surface created by the enlarged surface of the mat per lineal foot of wire.

The Central Electric company secured an order for transformers, aggregating 9,000 lights capacity, on the evening of January 13th, delivering the same day from its Chicago stock 2,000 lights capacity, and placing with the Wagner Electric Manufacturing company, for which it is general western agent, the balance of the order of 7,000 lights, via long-distance telephone, communicating direct from its office with the Wagner company. By 10 o'clock on the morning of the following day the goods were loaded into a special car, reaching Chicago the following morning and being installed complete at the Coliseum by D. Avery Kimbark, electrical engineer for the National Board of Trade of Cycle Manufacturers, on the 16th. From point of promptness this shipment is without question a "record-breaker," not only with reference of the shipment, but also regarding the manner in which the installation was made by Mr. Kimbark after the goods were turned over to him. The Central Electric company states that it has more transformers and general supplies, which it can furnish in the same prompt manner, and that its friends need not be over-modest about calling upon it, and that it will not be necessary to note on the bottom of orders, "Get a move on."

The annual meeting of the stockholders of the Standard Underground Cable company was held at the company's offices in Pittsburg, on January 26th, over 90 per cent. of the capital stock of $1,000,000 being represented in person or by proxies. The old board of directors was re-elected for the ensuing year, including one gentleman who entered the board during 1896—B. F. Jones, one of the largest iron manufacturers in the United States. The report of the board of directors showed a total business of nearly $750,000 for the year 1896; four dividends of two per cent. each were paid out of the earnings for the year, and the remainder was added to the surplus account. The assets of the company aggregate $1,412,046.06, and the liabilities, exclusive of capital stock, are $106,928.08, while the surplus over and above all liabilities (including capital stock of $1,000,000, is $308,107.19. The company's factories are reported in first-class condition for economical and rapid manufacture of wires and cables of all kinds, all departments running, and the rubber department being especially crowded with orders at this time. The prospects for 1897 are considered flattering, a number of large contracts, aggregating nearly $250,000, being now on the company's books, most of which have been secured since January 1st.

BUSINESS.

A. O. Schoonmaker's mica price-list for 1897 is out. It may be obtained by addressing Mr. Schoonmaker at 158 William street, New York.

The Metropolitan Electric company of Chicago has been given the western agency of the Bernstein lamps, both arc and incandescent. These lamps are among the best sellers on the market and have a widely extended reputation.

Eugene Munsell & Co., the mica dealers of 117-119 Lake street, Chicago, have a useful combination blotter which they give to their friends. The top piece gives the information that in the new quarters the firm is in a position to fill all orders promptly.

That Rainbow packing is a necessity to the central station engineer seems to be shown by the large number of imitators, but only the original has the well-known diamond trade-mark, prominently displayed on all of the packing produced by the Peerless Rubber Manufacturing company of 16 Warren street, New York. The secret of this packing is said to be known to only two men —J. H. Deming, the superintendent of the works, and the president, C. H. Dale—although Rainbow packing passes through at least 100 different processes before reaching the market.

Among the electrical installations under way or just completed by the Julius Andrae & Sons company of 225 West Water street, Milwaukee, are the following-named: Milwaukee Cold Storage company, isolated plant and the wiring for 250 lights; J. A. & P. E. Dutcher foundry, plant for electric lighting and for furnishing current to electric crane; C. J. Reynolds' apartment house, wiring, bells and door-openers; Waupun prison, two 15 horse power motors; C. J. Smith & Sons company, 25-station watchman's time detector; C. M. Davis' residence, wiring; Milwaukee Hospital for the Insane, three additional motors.

The descriptive circular and illustrated price-list of tested fuse wire and links manufactured by the Chicago Fuse Wire & Manufacturing company of 153 Lake street, Chicago, gives information about a class of electrical apparatus that is indispensable. W. R. Goodman is the manager of the company, which is now equipping its testing laboratory with the latest approved instruments, going to a large expense for this purpose, the intention being to make the product in all respects of the highest grade, and to sustain the company's claim that its line of fuse wire and links is the "standard for accuracy."

The demand for Alcatraz electrical compound, which is used extensively for insulating purposes, still continues to be very brisk, and for a new commodity the sales are unusual. Very strong statements are given by the California Asphalt company of 57 East Fifty-ninth street, New York, which is the manufacturer of this article, in regard to its insulating qualities for dynamos and motors, battery and accumulator shelving, cut-out boxes, and for coating wires where subject to acid or alkaline fumes, and also when laid under cement. General Sales Agent C. P. Williams has the entire control of the output of this concern, with offices at 39 Cortlandt street, New York.

The Granite State Mica Mining company, 503 Fifth avenue, New York, is the name of a new company which is now being formed to operate large mining interests for mica at Grafton Center, N. H., and the reports indicate that a very rich vein of mica has been found, and that the product is of the best, showing no mineral tracings. There is, without doubt, a rapidly increasing demand for a high grade of mica in the electrical business, and the fact that there is a scarcity of good mica makes it very hard at times for electrical concerns to get what is desired of this material. The Granite State company has secured 50 acres of land through which extends the main vein of mica, and it is claimed that the vein is between 75 and 150 feet wide and extends below the surface to a great depth. It is intended to purchase the very latest machinery for operating this mine as soon as the company is completely organized. Operations will be begun as early in the spring as possible.

The Siemens & Halske Electric company of America calls attention to the claims of some of its competitors that they absolutely own and control the patents covering all underrunning trolleys. This statement, the company says, can not refer to the Siemens trolley or contact bar, the well-known device in use all over the world, which has been described repeatedly; it makes a sliding contact with the trolley wire, making overhead construction very simple and doing away with the necessity of switches and frogs, besides making it impossible for the device to be "off the trolley." Further attention is directed to statements that certain American companies had patents on electric railway conduits and had installed what they pleased to term "the Budapest conduit system." The Siemens & Halske company says: "It is a well-known fact that the first successful electric conduit system—the Budapest conduit system—was installed by Siemens & Halske, Berlin, and all United States patents covering the main features of this system are owned and controlled by the Siemens & Halske Electric company of America." The company is prepared to furnish complete trolley stands and trolley contacts and to install complete electric conduit railway systems under the patents which it owns and controls, or it will license prospective customers under these patents.

The Ferracute Machine company of Bridgeton, N. J., manufacturer of pressing, punching and stamping machinery, had a successful year in 1896. During the early months it did considerable business in bicycle tools, and in the summer it secured some good orders for presses, dies and other machinery from the Chinese government. In the fall the secretary visited Europe and took a considerable number of orders. In addition the company had a fair American trade in bicycle and electrical machinery. A number of orders were received from electrical establishments in France, Belgium and Austria. During the year the Ferracute company made a number of improvements and reorganized its manufacturing and office arrangements. At the annual meeting held on the 15th of January the yearly report showed a profit sufficiently large to pay three per cent. semi-annual dividends on the common stock and 3½ per cent. on preferred stock. These were declared in addition to the dividends paid last July. The company is busy at the present time, running about 116 hands in the shops and about 30 men in the foundry, there being orders enough ahead to keep the full force employed for two or three months to come. It is adding a number of sizes of new presses to the already large list, and is paying particular attention to improvement in construction and finish.

ILLUSTRATED ELECTRICAL PATENT RECORD.

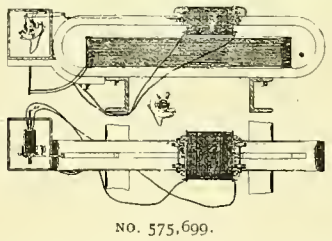
Issued January 26, 1897.

575,699. Electro-mechanical Movement. Edwin D. Chaplin, Cambridge, and Henry G. Halloran, Boston, Mass. Application filed March 21, 1896.

A plurality of field magnets and their armatures are employed, each field magnet and its armature being relatively reciprocable; means to produce a current in the fields or armatures and means to reverse the current in accordance with the relative reciprocation of the field magnets and armatures are also provided.

575,723. Railroad Truck. Alonzo C. Mather, Chicago, Ill. Application filed January 23, 1893.

The motor is mounted on top of the truck and projects into the car-body above it, having connections and bearings between the truck and the car-body, the connections and bearings being continuous and encircling the motor.



NO. 575,699.

575,724. Gearing for Electric Car Motors. Alonzo C. Mather, Chicago, Ill. Application filed December 1, 1893.

A car-truck bearing for connecting the car-body to the truck is the principal feature, the bearing encircling an electric motor which is mounted with its armature shaft horizontal; there are pinions on the shaft of the motor, sprocket wheels on the axle of the truck, a link chain, two toothed tighteners and springs, one on each side of the armature shaft.

575,767. Apparatus for Determining Electrical Resistances Containing Electromotive Forces. Oscar Frölich, Charlottenburg, Germany. Application filed May 11, 1895. Patented in Germany September 12, 1894; in France April 11, 1895; in Austria April 12, 1895; in England May 3, 1895, and in Hungary June 6, 1895.

Means are provided for causing variations in the current flowing through one of the diagonal branches of the Wheatstone bridge system, and means for measuring the ratio of the variations of the current in the two diagonal branches.

575,772. Röntgen-ray Tube. Elihu Thomson, Swampscott, Mass. Application filed August 21, 1896.

An apparatus for the generation of Röntgen rays, comprising a chamber having a Crookes vacuum and provided with a pair of concave electrodes, both of which face upon a bombarded metal-piece situated in substantially the focus of their concavities.

575,777. Electric Meter. Walter C. Fish, Lynn, Mass. Application filed October 16, 1896.

An armature is in shunt to the mains, with a non-inductive resistance in the armature circuit, a field coil, and means for periodically or intermittently weakening the field.

575,785. Closed Conduit Electric Railway. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed October 31, 1896.

This is a surface-contact system, and has an independent ground connection adjacent to the pick-up magnet contacts adapted to protect the coils on the pick-up magnets from extraneous or leakage currents.

575,788. Electric Smelting. Thomas L. Willson, New York, N. Y. Application filed February 20, 1895.

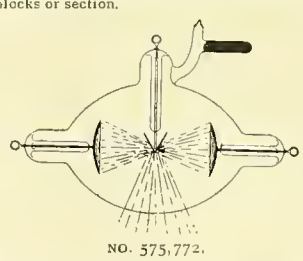
The process consists in subjecting the material to be treated in pulverulent condition to the continued action of an electric arc formed between separated electrodes by feeding such material into the immediate neighborhood of the arc, and maintaining the arc by an alternating current of a frequency adapted to set the mass of material into vibration, whereby by the pulsations of the arc the material is progressively drawn within its influence.

575,789. Brake Shoe. Frank E. Case, Schenectady, N. Y. Application filed May 13, 1896.

A pair of disk electro-magnetic brake-shoes, each mounted on a separate car-axle, and each having lugs and a retaining plate in combination with a locking-bar engaging the lugs on both shoes.

575,805. Electrical Signal System. Paul Freeman, New York, and Richard E. Slater, Montrose, N. Y. Application filed May 25, 1896.

One claim is given: In an electrical railway signal apparatus, the combination with a suitable frame, of a shaft passing therethrough and revolving in one direction, a plurality of suitably supported insulated bars mounted parallel with said shaft, a plurality of pairs of springs connected with said bars and pointing in the direction of said shaft, suitably insulated wedges connected with said shaft and adapted to contact with said pairs of springs, binding posts connected with each of said springs, said shaft being also provided with a crank, and a locking-rod connected therewith, and said locking-rod being adapted to be connected with the signal device, and an indicator connected with said shaft, which is designed to indicate the position of the blocks or section.



NO. 575,772.

575,829. Electric Furnace. John Joyce, Andover, and James A. Deuther, Boston, Mass. Application filed October 12, 1896.

The essential features are an upper and a lower electrode, with mechanism for moving the lower one from its normal position to expose the same to receive the material to be treated, and a feed mechanism operated by the movement of the lower electrode for feeding the material to be treated onto the lower electrode.

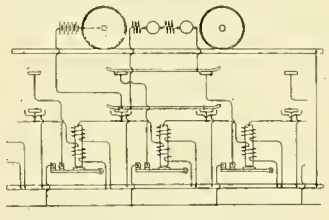
575,830. Printing Telegraph. Oscar L. Kleber, Pittsburg, Pa. Application filed July 18, 1895.

This arrangement comprises an electrical circuit, a message-transmitting device, a revoluble type-wheel, a number of selecting disks, a finger that will shift from one disk to the other and control the movement of the type-wheel, a paper-feeding mechanism, a printing hammer, an escapement wheel liberated by transmitted electrical impulses, and means for controlling the action of the escapement wheel and hammer.

575,869. Telephone Transmitter. Russell S. Barnum, Chicago, Ill. Application filed June 1, 1896.

Included in this device are a diaphragm and carbon block constituting two electrodes, and a mass of granulated conducting material, an obliquely disposed carbon tongue hinged to one and in electrical contact with both of the electrodes, the tongue projecting into but only partially surrounded by the granulated conducting material.

575,883. Electric Controlling Apparatus for Pneumatic Dispatch Tubes. Edmond A. Fordyce, Chicago, Ill. Application filed June 23, 1893.



NO. 575,785.

The dispatch tube has a series of receiving boxes; switches control the entrance to the boxes, and magnets in turn control the switches; there is also a circuit-controlling key for each switch; means are provided for locking the keys, a magnet controlling the locking mechanism, and a correction key controlling the circuit of the magnet, whereby the locking mechanism may be released.

575,896. Telephonic Transmitter. Maxymilian Kotyra, London, England. Application filed November 17, 1896. Patented in England April 1, 1895.

A granular telephone transmitter, comprising a vibratory helical case, carbon blocks at each end of the case, and granular microphonic material between the blocks.

575,908. Switch and Signal Apparatus. Jens G. Schreuder, Edgewood Park, Pa. Application filed September 21, 1895.

A series of electrically controlled motors operates a series of switches and signals or other appliances connected with a track; a series of make-and-brake mechanisms controls the circuits leading to the motors, and mechanical interlocking mechanisms are arranged to interlock the switch and signal make-and-brake mechanisms.

575,918. Brush Carrier for Dynamo-electric Machines. Schuyler S. Wheeler, New York, N. Y. Application filed May 26, 1896.

Claim is made for the combination of rings insulated from each other and mounted on the frame of the machine at the inner end of the commutator, brush-carriers on the rings extending over the commutator and brushes mounted on the carriers.

576,053. Electric Appliance for Horses. Lowry A. Gray, Arlington, Md. Application filed October 29, 1896.

An apparatus of the character specified consists of a girth having a source of electric energy and an induction coil, a circuit closer adapted to maintain an open circuit and to be secured upon the abdomen of the horse, a primary circuit and a secondary circuit including the circuit closer, a metal in electrical contact with the horse and the intervening portion of the body.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, FEBRUARY 13, 1897. No. 7

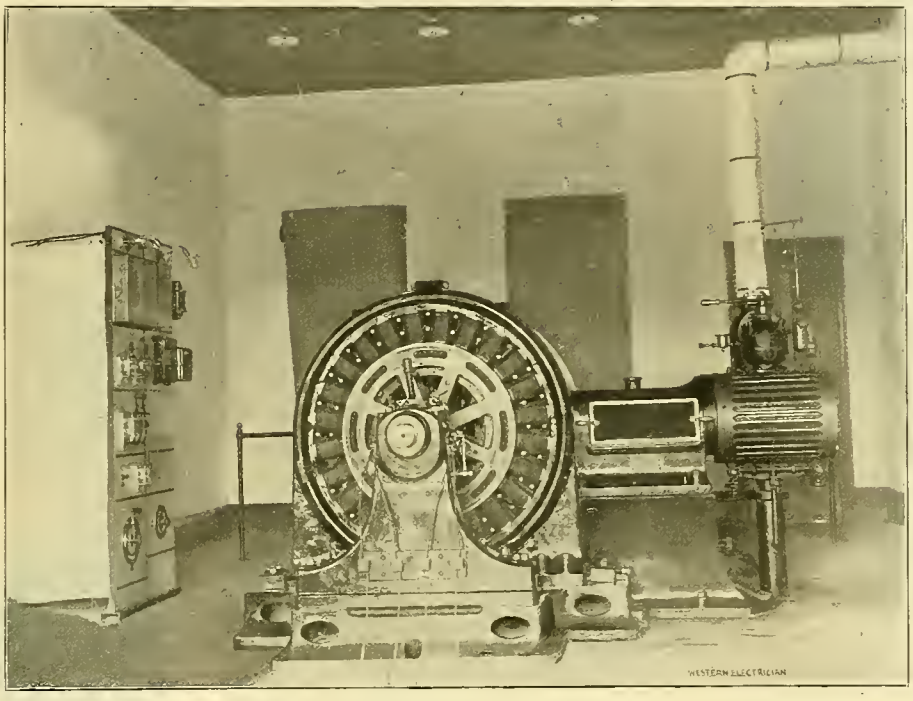
A Central Station of One Unit.

The small and compact central station plant shown in the illustration given herewith is the property of the city of Ames, Iowa, and is used to supply the town with incandescent and arc lighting, the latter for both street and commercial illumination. One unit, and that a medium-speed engine and alternator, supplies the current for all lighting purposes, and it is proposed to supply motors from the same mains, as demanded. It consists of a 75 kilowatt Westinghouse quarter-phase 1,100 volt alternating current generator of the engine type, direct-coupled to an Ideal 14 by 14 inch simple engine, operated at 300 revolutions per minute. There are also two 66 by 16 inch boilers, with heaters, pumps, etc.

From this dynamo residence and commercial incandescent lighting and street incandescent lighting, by ten 100-volt lamps in series across the primary mains, is supplied. The town has also 15 Westinghouse alternating current constant potential arc lamps for street use, run from separate converters. The same lamp is also used commercially.

The switchboard consists of two marble panels in steel frames, with marble and plate-glass instruments and one of the new Shallenberger integrating primary wattmeters for measuring the output of the station load. This is considered to be the finest central station of its type in the state of Iowa, being the first direct-connected alternator to high or medium-speed engine in the state.

The Westinghouse new style C. S. converters are used throughout. The entire plant has a primary voltage of 1,000 and a secondary voltage of 200 or 100. The converters are of larger size than usually used in this size station, very few small ones being used.



A CENTRAL STATION OF ONE UNIT.

Assignment of the Louis K. Comstock Company.

The Louis K. Comstock company of Chicago made an assignment to the Chicago Title & Trust company on February 3d. The company has been in the electrical construction business for several years, and Mr. Comstock and the gentlemen associated with him stand high in the estimation of electrical men in the West as honorable and reliable contractors. It is pleasant, therefore, to learn that there is every prospect that every dollar of indebtedness will be paid in full, with interest, and that the company will in due time begin business anew under the old name.

Estimates of the assets and liabilities place the former at $52,000 and the latter at $38,000. The cause of the failure was a load of $42,500 in securities which the company was carrying. It became impossible to realize on these as quickly as desired without an undue sacrifice, and in order to protect the interests of all the creditors the assignment was made. Nearly all the creditors are friendly to the company, and it is thought that with wise handling of the securities no material loss will result.

The business is at present conducted by L. K. Comstock and F. S. Richmond, who have quite a little work on hand and are actively in the field for construction business. Offices have been secured at 1108 and 1109 Fort Dearborn building.

Farmers' Use of the Telephone.

At the recent meeting of independent telephone men in Fort Wayne, Ind., Judge James M. Thomas of Chillicothe, O., president of the Ohio Telephone Exchange association, made an interesting address. Dwelling on the future of the telephone and the possibilities of the independent exchange, Judge Thomas said that it was only a matter of a few years, when the independent idea had been more fully and more practically developed, that the farmers would want telephone service and be ready to pay for it as a profitable investment of a part of their means. Already, he said, the farmers appreciated the advantages of the telephone and the facilities it afforded them for prompt communication with markets, with business centers, with all sources and places and on all occasions where economy of time or the possession of information in advance of leaving their homes was of use and value. Every day, he said, farmers called at the office of his company in Chillicothe to make inquiry about securing telephone service. "It is hardly practicable just now," said Judge Thomas, "but the time is coming and is not far distant when every farmer owning 100 acres of land within 15 miles of his county seat will have telephone service in his home."

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Northern Wisconsin Telephone company, with headquarters at Gillett, Wis., is arranging for a telephone line to connect Green Bay with Gillett, Pulcifer, Cecil, Bonduel, Shawano, Angelic, Frazier, Hoffa Park, Roselawn and Seymour, with branches to Lange, Mills Center and Seymour.

Chas. G. Cockerill of the Jefferson, Ia., Telephone company has been prospecting in the northwestern part of the state with a view to extensions in that direction. He was encouraged by what he learned.

The telephone company at Omaha, Neb., will build a line to Kearney, Neb., and intervening points in the spring.

A telephone line from Yankton, S. D., to Vermillion, S. D., making connections at the latter point with points in Iowa, Minnesota and Nebraska is said to be a certainty for this season. It was decided on last year, but work was deferred.

A telephone line connecting Waconia and Chaska, Minn., is contemplated.

Another telephone exchange is threatened at Marshalltown, Ia.

J. H. Gunn and J. L. Brooks of Seymour, Ia., are figuring on putting in a telephone system connecting the various towns in Appanoose county, similar to that in Wayne county.

The Northwestern Telephone company is figuring on establishing an exchange at Green Bay, Wis.

A telephone line is talked of extending from St. Nazianz to Kiel, Wis., via School Hill, Louis Corners and Rockville, and probably finally to Sheboygan. A scheme to connect Grantsburg, Wis., and Trade Lake is also proposed.

The Jefferson Telephone company of Jefferson, Ia., contemplates extending its system to Sac City and other points.

The Mississippi Valley Telephone company, of which J. C. Hubinger, the Keokuk, Ia., capitalist, is backer, is an applicant for a franchise at Davenport, Ia., Rock Island and Moline, Ill., and has secured the franchise of the Burlington, Iowa, and Heodersoa County Telephone company by purchase. The company projects a line which shall eventually include all the prominent points from St. Louis to Minneapolis and St. Paul. The company has issued a roseate circular to prospective patrons, in which it agrees to give excellent service at low rates and extends an invitation to visit the company's exchange at Keokuk. The old company has been combatting the advances of the new one at Davenport by reading notice advertising which states the great number of independent telephone companies which have gone out of business, etc.

The Union Electric Telephone company of Waucoma, Ia., will have telephone connection with Owatonna, Minn., soon.

The Northwestern Telephone & Electric company of Milwaukee, which is now building a toll line from Marinette, Wis., to Marquette, Mich., contemplates a line from Ashland, Wis., to Chicago, via Marinette.

The success of the telephone line between Rush City, Minn., and Danewood, Minn., nine miles, has been so great that plans are being made for an extension of the system from Danewood to Braham, thence to Mora and thence to Brunswick in the spring. Some of these places have no railroad connection, and as their freight goes to Rush City the telephone will be of great use to ascertain whether expected freight has arrived.

It is stated that about 1,900 miles of electric railway track—or, assuming this to be mostly double track, say 950 miles of line—was built in the United States during 1896. As the total length of steam railway main line laid in the same time was a little less than 1,900 miles, it appears, says the *Railway Age*, that the new mileage of electric roads was about one-half that of steam roads. While steam railway building has fallen off very rapidly since 1890, electric railway building in the same time has increased at a surprisingly rapid ratio, and it looks as if the yearly construction might soon surpass that of the steam roads.

The Enclosed Arc Light.

By L. B. Marks.

Part II.

Blackening of the Internal Surface of Enclosure.—Before taking up the analysis of the latest development of the art, let us pause for a few moments and examine into the underlying principles governing the successful operation of enclosed arcs of to-day. Let us start out with the operation of an enclosed arc within an air-tight compartment to which the outside atmosphere has absolutely no means of communication. The photograph reproduced in Fig. 2 represents such a structure and illustrates the results which follow the passage of current. I shall show you the stereopticon view of the apparatus on the screen later on. You will note that the glass, which was originally cylindrical, now has a large spherical protuberance at the side. You will also note that the chamber is coated on the inside with a heavy black deposit. This apparatus was originally air-tight and the carbons in contact. Current was passed so as

FIG. 2. THE ENCLOSED ARC LIGHT.—RESULT OF ENCLOSING THE ARC AIR-TIGHT.

to form an arc, and in due time the length of this arc increased from 0 to about 9 millimeters as the carbons consumed. The bulb began to blacken after the oxygen contained in it went into chemical combination with the carbon vapor of the arc stream. Such a result is natural, as the disintegration of carbon must go on as long as the arc plays; the carbon having no substance with which to combine, is thrown off in the form of a black soot on the internal wall of the chamber. Moreover, as in this case, when there are no means of exit for the expanded gases, the pressure is sometimes sufficient to distend and rupture the envelope.

Although the blackening of the internal wall of the chamber always follows the operation of a carbon arc in an air-tight enclosure, the same discoloration may occur under other circumstances when the enclosure is not air-tight or even nearly so. This second case is illustrated in a cylinder in which the annular space around the entering carbon permitted of access of oxygen to the enclosure. The blackeoing was due to a large current and a short arc. In the photograph (reproduced in Fig. 3) I have placed a clear cylinder alongside of the other for comparative purposes. You will note that the deposit is inky in color and quite uniformly distributed over the surface of the glass. In this case the carbons were burned for three hours at a current of 18 amperes, the arc tension being 30 volts. The amount of impurity in the carbons was inappreciable.

Having thus reviewed the fundamental conditions governing the operation of enclosed arcs, we will now confine our attention to the most important phase of the subject, namely, the high-potential enclosed arc.

"Pioneer" (Marks) High Potential Enclosed Arc Lamp.—We have seen that all the types of enclosed-arc lamps described up to this point have been deficient in various particulars. As far as commercial operation is concerned, none of them has been a success. It remained for a lamp operating on a new principle to fulfill the requirements exacted by the commercial practice of the day. Such a lamp had to satisfy the following conditions: First, standard, steady light of uniform distribution; second, efficient arc; third, long life of the carbons; fourth, no blackening or discoloration due to the disintegration of the carbon.

These conditions were fulfilled in a lamp, an account of which I presented for the first time before the National Electric Light association of America in February, 1894, and which I called the high-potential incandescent arc. The high-potential enclosed arc, as its name indicates, was so called on account of the high voltage of the arc. High voltage is, of course, a relative term, and is applied in this case in contrast to the usual voltage of the arc, viz., 40 to 45 volts. In experimenting in this line I found that arcs could be steadily maintained at double the voltage of the ordinary arc, and under some conditions even at three or four times the voltage. Arcs of such high voltage are naturally quite long and require apparatus specially adapted to operate them. I found that under proper conditions these long arcs could not only be maintained continuously, but so operated with a remarkably small current, thus resulting in high efficiency and long life of the electrodes. Experience has shown that this method of operation is the only one which has been successfully applied to existing commercial circuits. A glance at the cut, Fig. 4, in which marginal notes indicate the principal parts of the lamp, will show that the operating mechanism consists simply of a pair of solenoids, armature and cores, lazy clutch and carbon rod. This mechanism is designed so as to spring a long arc of about 10 millimeters or more. The design of the solenoid is such that the current consumed by the lamp will be very small and quite uniform throughout the range of the lamp. The enclosing bulb is mounted in the lower carbon holder and, as will be seen from the notation on the cut, is closed at the top by a special device known as a gas-check plug. The lower carbon in this lamp is 12 centimeters long and the upper carbon 30½ centimeters long; both pencils have a diameter of 11.11 millimeters. At the top of the lamp is mounted a small resistance coil. The standard lamp is designed to pass a current of from four to five amperes, 80 to 85 volts being the drop across the arc.

The Gas-check Plug.—The plug which forms a closure for the bulb is such a unique device that I have deemed it worthy of a special representation in another cut, Fig. 5, where you will note the gas-check plug is shown in cross section mounted in the mouth of a cylinder. If we close the mouth of the bulb simply by a flat metal disk having an opening in it sufficiently large to allow for variation in diameter of commercial carbons, we find it difficult to prevent an abnormal access of oxygen into the enclosure. The gas plug was devised to check the circulation of ingress and egress and still have the same sized opening leading into the enclosure. The comparative measurements with and without the gas-checking device will be given later on.

It will be noted that in order to retard or check the flow of gases into and out of the bulb, the plug is provided with a depending cylindrical metal tube about 1½ centimeters long, the lower end of which is slotted so as to allow of communication between the gases on either side of the wall formed by the tube. The opening around the carbon may with advantage be enlarged so as to form a secondary chamber for the gases, as shown in the cut, Fig. 6. Now, after the lamp has been in operation for a few moments, the heated gases from the arc instead of having an unobstructed egress, are met by another body of gas at the plug, resulting in the production of eddy currents, which tend to check the circulation of the outgoing and incoming gases. I have in my hand a model illustrating the principle of the gas-check plug. Instead of the lower carbon I use an ordinary wax candle. Instead of the upper carbon I use a strip of metal to serve as a longitudinal diaphragm adapted to show the circulation of the gases. The depending cylindrical metal tube which projects into the bulb is provided at its lower end with slots just as explained before. In order to show the gas-checking action very distinctly I have arranged to open and close the slots at will. The conditions you will see represent exactly those which exist in the case of the lamp. I now light the candle. If I remove the metal strip which forms a dividing wall for the gases, the circulation of air into the enclosure will be stopped almost instantly and the candle goes out. If the strip be inserted thus, representing the upper carbon in its normal position in the lamp, and the candle be relighted, you will note that the flame continues to play, the cool air finding a path for admission on the one side and the heated gases having an unobstructed egress on the other. Thus far the slots in the depending tube have been closed. I now open these. You will note that the circulation of gases is quickly checked and the flame grows dimmer and finally becomes extinguished. The heated gases are diverted in their course, and instead of passing freely out of the enclosure, tend to fill the bulb with a de-oxygenated atmosphere, thus illustrating the action of the gas-check plug of the enclosed arc lamp.

TABLE OF LIFE TESTS.

With and without gas-checking attachment; carbons, 11.11 millimeters in diameter:

Mean current (amperes.)	Mean arc tension (volts.)	Mean energy (watts.)	Consumption of (+) carbon per hour (in millimeters.)	Consumption of (—)carbon per hour (in millimeters.)	Total consumption of carbon per hour (in millimeters).	Remarks.
7.98	63.86	509.65	2.118	.538	2.656	No gas-check
7.99	63.4	506.56	1.483	(—).152	1.331	Gas-check
8.03	61.77	496.12	2.751	.424	3.175	No gas-check
8.06	63.5	511.81	1.161	(—).076	1.085	Gas-check

Life Tests.—First, with and without gas-checking attachment. The use of the gas-check plug makes it possible to prolong the life of the carbons far beyond that which can be reached without employing this device. In the table before you I give the results of tests made with and without the gas-checking attachment, other conditions being practically the same. You will note that in one of the tests the total consumption of carbon with the gas-check plug was only a trifle over one-half and in the other a shade more than one-third of that resulting from the omission of the gas-checking attachment. The prolongation in the life of the negative electrode was exceedingly marked, the latter having increased in length in each case when the gas-checking attachment was used.

Second, with carbons 11.11 millimeters in diameter in five-ampere lamp. A pair of carbons which in the ordinary open arc will burn from six to eight hours will last from 100 to 150 hours in commercial practice in the high-potential enclosed lamp which I have already described to you. A life test of a pair of carbons 11.11 millimeters in diameter, operated in the standard lamp, is given below. This is a report on the performance of a lamp which is in service about four hours every day. The total run was 121 hours.

Third, with carbons 12.7 millimeters in diameter in four-ampere lamp. When the diameter of the carbons is increased the longevity is greater, but other objections are introduced which will be treated of under the heading of "Efficiency of the Enclosed Arc." The life test of a pair of carbons 12.7 millimeters in diameter running about 12 hours per day in a four-ampere lamp is appended.

TABLE OF LIFE TEST.

Of carbons 11.11 millimeters in diameter, in "Pioneer" five-ampere enclosed arc lamp:

Original length	(+) carbon	306.387	millimeters
" "	(—) "	121.10	"
Final "	(+) "	109.537	"
" "	(—) "	82.55	"
Total run		121.	hours
Consumption	(+) carbon per hour	1.652	millimeter
"	(—) " " "	.319	"
Maximum current		5.25	amperes
Minimum "		4.65	"
Average "		4.95	"

TABLE OF LIFE TEST.

Of carbons 12.7 millimeters in diameter, in "Pioneer" four-ampere enclosed arc lamp:

Original length	(+) carbon	304.80	millimeters
" "	(—) "	128.587	"
Final "	(+) "	114.30	"
" "	(—) "	77.787	"
Total run		199.	hours
Consumption	(+) carbon per hour	.957	millimeter
"	(—) " " "	.255	"
Maximum current		4.5	amperes
Minimum "		3.8	"
Average "		4.15	"

Efficiency of the Enclosed Arc.—On a previous occasion I published some curves showing the relative radiant efficiency of the enclosed arc, one of which curves I will reproduce here for you in contrast with an efficiency curve of an average open arc. Referring to

FIG. 3. THE ENCLOSED ARC LIGHT.—BLACKENING AT LOW VOLTAGE OF ARC.

the illustration (Fig. 7), the dotted line curves indicate the relative luminous and total radiation respectively. The ratio of the luminous to the total radiation of the lamp at various angles below the horizontal is given in the heavy line curve, which therefore represents the radiant efficiency of the arc. In the case of the enclosed arc the measurements are given for a clear-glass enclosure; in the case of the open arc the readings are given for the naked arc, no globe having been used. The mean hemispherical efficiency of the enclosed arc was found to be 8.4 per cent.; that of the open arc for the same current 11.7 per cent. It will be noted that the efficiency curve of the enclosed arc differs materially from that of the open arc, the distribution of light in the former being more uniform than that of the latter. In the enclosed arc the change in efficiency from 20 to 60 degrees is inconsiderable, while in the open arc the change is decidedly marked, the curve taking a very sharp turn at about 40 degrees.

The figure which I have given for the efficiency of the naked arc is much higher than that of the average naked arc in service in the United States. From tests which I have made, it is safe to say that as commercially operated the average efficiency of the open arc lamp falls considerably below 10 per cent. without deducting the loss due to the interposition of a clear or translucent glass globe. When we consider the case of

an open in-door lamp with an opal globe such as used extensively in this country and compare the same with that of an enclosed arc lamp as commercially operated, the relative radiant efficiency measurements as given above do not represent the true relative illuminating powers in the two cases. With the open arc for in-door illumination it is necessary to soften the light; in other words to enlarge the area of the source of illumination. With the common opal globe it is found in practice that from 40 to 60 per cent. or more of the light is necessarily cut out in obtaining the requisite distribution just alluded to. With the enclosed arc, on the other hand, where a thin outer globe is used, this distribution can be obtained with a loss of not more than one-half of that in the case of the open arc, especially when the inner bulb of the enclosed arc is made of a slightly translucent glass.

The conservation of heat in the enclosed arc makes it possible to operate a carbon of given diameter at a relatively higher efficiency than in the open arc. Thus a carbon 11 millimeters in diameter operated in the enclosed arc lamp at a current of from four to five amperes will give about the same efficiency relatively as a carbon eight millimeters in diameter operated at the same current in an open lamp. This makes it possible to use a carbon of large diameter more efficiently in the enclosed lamp than in the open lamp. It is found, however, that with these small currents it is expedient for several reasons to use carbons appreciably larger in diameter than the size quoted above.

First—With the larger carbons the radiation is more rapid and the temperature is decreased; the efficiency, being a function of the temperature, is therefore also decreased.

Second—The amount of light cut off by the carbons themselves when the latter are large in diameter becomes considerable. This applies especially to the rays cut off by the flattened tip of the negative carbon.

Third—The coating of the internal surface of the enclosure cuts off light in proportion to the thickness of the deposit. It is well known that all carbons contain a small percentage of impurity, consisting chiefly of silica. When the carbons are consumed in the open arc this silica passes off into the atmosphere. When the carbons are consumed in the enclosed arc the impurity settles in the form of a thin coating on the internal surface of the enclosure. Although the amount of this deposit is very slight when the carbons are burned only for a short time, the amount of light cut off becomes appreciable when the coating thickens. It has been found in commercial operation in the United States that after 100 hours' burning the decrease in the illuminating power of the lamp due to the formation of this coating is not noticeable by the consumer; after about 150 hours, however, the decrease in illumination becomes objectionable, and it is necessary to wipe out the enclosing bulb. Now, with a pair of carbons 12.7 millimeters in diameter, the life, as shown in the test which I have cited for you, is about 200 hours. As a result of this long burning the light efficiency is cut down to an objectionable extent; hence in this case we are using a large carbon at the sacrifice of efficiency from all three standpoints mentioned above.

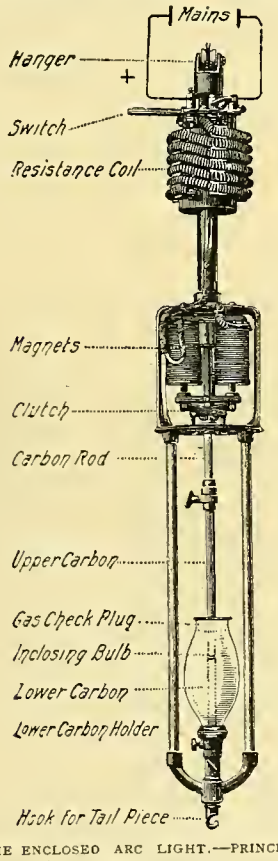


FIG. 4. THE ENCLOSED ARC LIGHT.—PRINCIPAL PARTS OF LAMP.

In the candle power curves which I have given here for comparative purposes (Fig. 8) the same difference in distribution of light will be noticed as in the case of the efficiency measurements. The mean hemispherical candle power of the enclosed arc as determined from the curve is 431, the watts per candle being 1.17. The corresponding values for the open arc are 425 and .953. In the case of the enclosed arc the maximum candle power, as may be deduced from the curve, is 595, while the corresponding candle power of the open arc is 1,080. The figures for the open arc are taken for a brand of carbon in extensive commercial use in the United States. In the candle power curve for the open arc the readings begin at 200 instead of 0.

It will be noted that, although the maximum candle power of the open arc is almost twice that of the enclosed arc, the mean hemispherical candle power of the former is a trifle less than that of the latter; in general, it will be found that, because of the comparatively deep crater in the positive carbon of the open arc, the difference between the maximum candle power and the mean candle power is very great; in the enclosed arc, on the other hand, especially when the bulb is made of a slightly translucent glass, this difference is very slight.

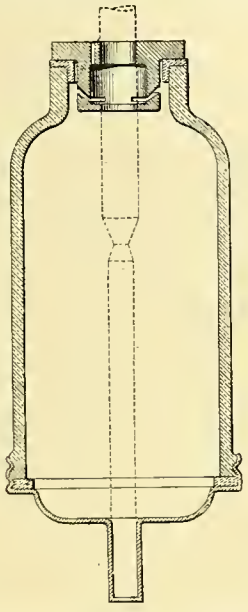


FIG. 5. THE ENCLOSED ARC LIGHT.—ENCLOSURE WITH GAS-CHECK PLUG.

A comparative test of candle power of the open and enclosed arc lamps respectively was made here recently by one of the illuminating companies, and I submit the report of same to you. The candle power measurements represent the relative illumination produced in actual practice. The open lamp was provided with the usual opal globe in common service here, and the enclosed lamp with an opalescent inner and a thin opal outer globe such as used in the standard enclosed arcs. For the same wattage the excess of candle power was slightly in favor of the enclosed arc lamp.

It is difficult if not impossible to obtain a true value of the effective illumination of an arc lamp, especially of the enclosed arc, in terms of candle power. In interpreting the candle power tests of arc lamps this fact must be taken into consideration. The quality of the light emitted by the enclosed arc differs from that of the open arc, and on this account comparative candle power measurements must always be lacking more or less in truly representing the relative values of the lights. I have found in some cases that an enclosed arc, although producing actually less candle power than an open arc, has given more available illumination, and on this account met the demands of the consumer better than did the open arc. The number of open arc lamps which are daily being displaced by enclosed arcs in the city of New York alone is the best evidence in proof of the fact which I have cited.

TABLE OF CANDLE POWER TEST.

"Pioneer" four-ampere enclosed arc, and "Ward" eight-ampere open arc:

Mean watts arc, enclosed lamp	349
Mean watts arc, open lamp	346
Excess of watts, enclosed arc	1 per cent
Excess of candle power, enclosed arc	2¼ per cent

Extensive Electric Railway Project in Ohio.

The Cincinnati, Hamilton & Dayton Traction company has been incorporated in Ohio to lease, own, acquire, build, operate or maintain, either alone or in conjunction with any other street, suburban, interurban or other railway company, street, suburban or interurban railways, to be operated by electricity, steam or any other motive power, to do a freight and passenger business. This company is organized by the Cincinnati, Hamilton & Dayton Railroad company to equip certain portions of its line electrically. The latter company is financially strong and controls a large and well-known system of railroads. Its lines are nearly 700 miles long and reach most of the principal cities in Ohio, as well as penetrating to Indianapolis, Ind. It is stated that the new company will probably build and operate 100 or 200 miles of interurban railway within the next two years. It is expected by May 1st to operate 17 miles of standard-gauge road between Middletown and Hamilton, Ohio, by electric motors. This will be followed by an electric line between Hamilton and Cincinnati. Steam locomotives will be continued in use on the main line of this system, but it is possible that in the future electric motors may also be used on the principal as well as the branch roads.

Gaseous Fuel as a Means of Cheapening Electricity.[1]

By Nelson W. Perry, E. M.

In these days of extending areas to be reached by electric light and power companies, the management is constantly being put into a quandary as to how they are to be reached. In electric lighting enterprises employing the direct current the areas that can economically be reached are already pretty well covered, and these are the best paying areas. Just beyond there is new business to be had, if it only could be supplied, but to supply it would involve additional outlays far out of proportion to the reasonable expectation of immediate returns. The management therefore feels that it must for the present at least forego the immediate increase from these outlying districts and must depend for new business upon the natural or stimulated growth of custom within the districts already partly supplied.

Where the alternating current is employed very largely increased areas are so easily made tributary to the central station that the temptation to supply scattered customers has been in most cases too strong to be resisted, and I believe if reliable statistics could be compiled they would show that alternating current lighting stations have proved far less profitable as a class than have those using the direct current. The very limitations which have prevented the direct current entering the field to which the alternating current is best adapted have proved its greatest safeguard.

A comparative study of a very large number of load lines of direct and alternating current lighting stations discloses a peculiar state of affairs, viz., that as a rule the alternating current load lines have almost uniformly a squarer and broader topped peak than have the direct current stations. This is largely due in some cases to the fact that in the scattered service of the alternating current a very much larger proportion of the total output is employed for street lighting, but it is also partly due to the larger proportionate losses at light loads due to transformer and other losses peculiar to the alternating current, which makes the mean load higher than it should be. This feature is particularly observable in the curves of an alternating current station of which I have diagrams for nearly every day in the year, which supplies such a small proportion of its total output to street lights as to render the effect of these practically negligible.

Gas-check plug (fits in mouth of bulb). Enclosing bulb (surrounds the carbons). Lower carbon holder (supports the bulb).

FIG. 6. THE ENCLOSED ARC LIGHT.

With the direct current system, the introduction of high-voltage lamps, which have already demonstrated their feasibility abroad and to a less extent in this country, will be a partial solution of the question of supplying greater areas if it does not lead to the same temptation which has beguiled the alternating current manufacturers, for of this there is constant danger.

In electric railways, in which distances rather than areas are involved, the question is far more serious, for in this latter case the cost of distribution increases almost strictly as the square of the distance, whereas in electric lighting the cost approaches more closely to a direct proportion to the distance.

This comparison becomes more strictly true when we consider the suburban extensions of our electric roads, which in fact are now becoming about the only extensions open to our street railway managements, and the unfavorable character of the comparison puts the street railway problem in a still more unfavorable light when we consider that in the outlying districts the immediate traffic to be gained by the largely increased outlay is disproportionately small to that outlay and of a far more irregular character.

1. Read before the Northwestern Electrical association at Milwaukee January 21, 1897.

In order to make such new lines profitable at all it has become quite popular to stimulate traffic by inaugurating pleasure resorts and providing amusements at the farther end of the line. The wisdom of this is questionable, for to provide for this induced traffic, provision must be made both in the way of increased plant and additional copper largely in excess of the natural demand. This increased provision is at best utilized but a small portion of the time and the earning capacity of the investment as a whole is greatly decreased.

Returning to the electric lighting industry, it is at best on an unsatisfactory basis, and something must be done to better it. In the most desirable locations, which are in our largest trade centers, such as Chicago, New York and Boston, where probably of all places in the world the electric lights are most dense, and therefore where they can be supplied at least cost for distribution, what do we find? We find these companies whose stocks are selling above par and which are paying dividends regularly, making new issues of stocks and bonds or applying for permission to do so, in order "to raise funds for extensions."

Take the New York Edison Illuminating company as an example, whose stations are perhaps as favorably located as any to be found, and whose stock is selling above par. It has capital stock of $10,000,000, of which $7,938,000 has been issued, and of bonds $7,118,000, of which $6,430,000 has been issued, making a total authorized capital liability of $17,118,000, of which $14,368,000 has been issued.

According to its report for 1895 its total maximum capacity was 75,000 amperes or the equivalent of 150,000 16-candle power lamps. According to John W. Lieb,[1] the load factor of the combined Edison stations on the day of the greatest output in 1894 (December 10) was 34½ per cent.

To compare the capital outlay for electrical service with that required for equivalent gas service is exceedingly difficult; first, on account of the paucity and unreliability of gas statistics, and second, because of the well-known enormous over-capitalization of gas enterprises in New York, partly due to the watering of stocks and partly to the duplication of plants that would have been totally unnecessary had the gas industry grown legitimately under a single head instead of being the outgrowth of repeated consolidations of competitors in the same territory. But taking these statistics as we find them, the total authorized capital of the various gas companies, including stock and bonds, is given as $58,109,000, and their united annual output, as near as I can get it (average of two estimates by different gas authorities) 14 billion cubic feet. This gives a mean output per hour of 1,600,000 cubic feet. Counting five cubic feet per hour as the equivalent of a 16 candle power incandescent lamp, this means an average supply of 320,000 lamps, and if the load factor be assumed the same as given for the Edison stations, it means a maximum supply for something more than 927,000 burners. This is in round numbers 6.2 times as many lights as the Edison company on a total authorized capitalization of $17,118,000 is able to supply. On this basis the capitalization necessary to supply the same number of lights as the gas companies can now furnish, would be $106,000,000 as against $58,000,000 for the gas companies. For many reasons, some of which have been specified, the comparison is manifestly unfair to gas, and it seems not at all improbable that gas service can be supplied on a capitalization of not to exceed one-fourth (instead of one-half as here shown) that required for equivalent electric service.

There is certainly something wrong in this state of affairs, which the electrical engineer must correct. The most significant feature of the situation is that notwithstanding the fact that gas is distributed over very much greater distances than low-tension currents are, the consumer can buy it so cheaply that he can produce electric light more cheaply by burning it in a gas engine, even after incurring the losses in conversion in the engine and dynamo, than he can buy it from the electric company. If this be true in large cities like Chicago, New York, Philadelphia, Brooklyn and Boston, and it cannot be gainsaid, what must be the condition of light and power plants in smaller and less favorably situated cities?

Some, by rigid economy and the best of management, are making a little money; more are running on a very close margin, and still more are undoubtedly eking out a precarious existence while their machinery is wearing out and making no provision for its replacement when it requires renewal, and all are charging more for their light than gas can be and is furnished for, where gas is furnished at all. It is very clear if the electric light could be furnished at a small profit at the same price as gas it would furnish an enormous increment to the electric light manufacturer's income. The advantages of electricity as a useful agent in the household over gas are so apparent that there could no longer be any competition between the two. It would result in larger profits for those companies now making money and place most of those now operating at a loss upon a dividend-paying basis.

Our electric railways, except in exceptionally favored situations, as in our larger cities, are in no better condition than the lighting companies, if in fact they are in as good condition.

Our electrical engineers have bent every effort to ameliorate matters, and the best of our electrical stations are now models of mechanical and electrical engineering skill. Boilers of the highest efficiency, engines of the greatest economy and all the accessories have been brought to a state of perfection which leaves little expectation for improvement in those directions. Greater distances have been brought under the service of existing stations by means of the booster and of subsidiary outlying storage battery centers of supply, and the load line has been leveled off by the storage battery plants at the station itself, and yet the most optimistic will not maintain that finality has been reached or that the desired end has as yet been accomplished. Electricity can be produced at the station by large compound condensing engines more cheaply than can gas light at the gas works. If we assume that illuminating gas costs but 20 cents per 1,000 cubic feet to manufacture and that five cubic feet per hour are consumed to produce 16 candle power, the cost per light per hour at the gas works would be one-tenth of a cent. If on the other hand we assume that an electrical horse power hour can be produced at the central station for one cent, and that thirteen 55 watt lamps can be supplied thereby, they would cost one-thirteenth of a cent per hour.

When we still further consider that recent tests in England have shown that a brake horse power can be produced under test conditions in a gas engine on 14 cubic feet of ordinary town gas (16 candle power), and that such gas costs delivered in our large cities only about $1.50 per 1,000 cubic feet, it becomes evident that we can pay the gas company its profit on manufacture, distribution and collecting and still produce electric light in our central station at a less cost than gas light; and yet when we have distributed our energy to our customers we must charge them more than the gas company does, light for light, and then be satisfied with far less profit on an increased investment than the gas company gets on its lesser investment. It seems to me that this indicates something radically wrong and in a direction to which our engineers have given little attention, viz., in our methods of distribution.

We have constantly striven to increase our radii of distribution and have done this until we could go no farther and give satisfactory service. We have then built additional stations, and many managers now find themselves again confronted with the same question: Is it possible for me to increase my radius, or must I decide between foregoing the increased business just beyond my reach or taking the bull by the horns by building another station?

Unquestionably the gas engineer has the advantage of the electrical engineer in his method of distribution, but he has this advantage solely through the apathy of the electrical engineer and not through any inherent right. The facts are indeed the other way, for the pressure at which the gas engineer may distribute his gas is limited to that at which gas can be burned at its most efficient rate. No such limitation is placed upon the engineer who distributes gas for fuel purposes. Compressed air is being daily delivered through 20 miles of pipes with a pressure at the point of delivery of approximately 100 pounds to the square inch and a leakage loss not to exceed 10 per cent., and gas for fuel purposes can be delivered through the same pipes at the same pressure and leakage; whereas for illuminating purposes the final pressure is limited to a fraction of a pound in pressure to the square inch. But even under these conditions the Consolidated Gas Light company of New York is distributing gas from the Harlem River clear down to the Battery—a distance of 13 miles—and the Gas Light & Coke company of London is delivering gas over 70 miles of territory through 2,000 miles of mains to a distance of 17 miles from its stations. On the same investment in pipes, therefore, a far greater gas delivery can be made for power purposes than can be made for lighting purposes, and the electrical engineer who will deliver his energies to his centers of distribution in the gaseous form will have an enormous advantage over the gas company by reason of his ability to distribute his gas at greater pressure.

But he must be careful not to throw away the advantage thus gained by distributing his electrical energy over too extended areas. It is my conviction that the tendency to increase the radius of distribution is in the wrong direction and that our solution is in the contrary direction, viz., in increasing the number of our centers and decreasing the radii.

As regards the economy of distribution of energy in the gaseous form, I gave some figures in another place[1] which I ask permission to quote here.

I assumed that we wished to transmit our gas to a distance of 5,000 yards or nearly three miles, through a 12 inch pipe; that this gas has a specific gravity of 0.55 as compared with air, and that its calorific power was such that when burned in a gas engine under fair conditions it would require 25 cubic feet to produce one brake horse power hour. In order to allow for bends, I assumed that there were 25 90-degreee bends, or an average of one every 200 yards. The results obtained under varying initial pressures were as follows:

Inches water pressure.	Cubic feet delivered.	Increase of pressure required for each 90° bend.	Total increase of pressure for 25 90° bends.	Total initial pressure in inches required to deliver gas.	Horse power delivered (25 cubic feet one horse power hour).	Foot-pounds per second consumed in transmission.	Velocity of flow in feet per second.	Per cent. of power transmitted consumed in transmission.
1 inch	12,500	.0016 inch	.04 inch	1.04 inches	500	17.3	4 feet	.007
2 inches	18,500	.0034 "	.085 "	2.085 "	720	51.5	6 "	.013
3 "	23,000	.006 "	.1495 "	3.15 "	920	105.12	8 "	.0208
4 "	25,500	.0076 "	.189 "	4.189 "	1,020	151.5	8.8 "	.027
5 "	28,000	.0086 "	.215 "	5.215 "	1,120	204.7	9.6 "	.033
6 "	32,000	.0113 "	.28 "	6.28 "	1,280	284	11. "	.04
7 "	34,000	.0135 "	.34 "	7.34 "	1,360	359.	12. "	.048
8 "	36,000	.0147 "	.39 "	8.39 "	1,440	430.	12.5 "	.054
9 "	38,500	.0158 "	.4 "	9.4 "	1,540	501.	13. "	.06
10 "	40,000	.0183 "	.46 "	10.46 "	1,600	602.	14. "	.07

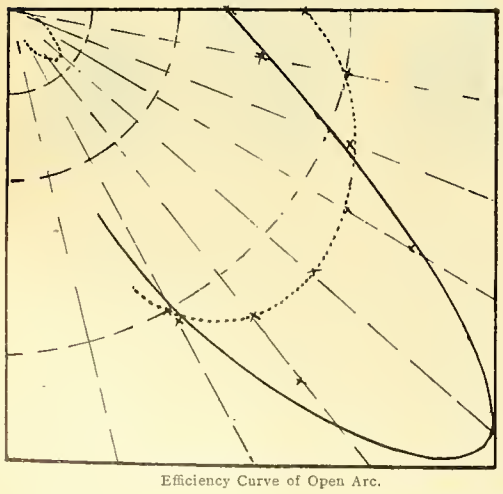
This shows that by this means 1,600 horse power can be delivered under 10 inches of water pressure through a 12 inch pipe with 25 ninety degree bends at a distance of 5,000 yards with an expenditure of but 1.12 horse power or $\frac{1.12}{1600}$ of one per cent. of the power delivered.

The Gas Light & Coke company of London in its straight-away transmission of 17 miles, which is comparable with some of our longest electrical transmissions, uses 30 inches initial pressure. With this pressure we could deliver through the 5,000 yards of 12 inch pipe approximately 2,700 horse power with an expenditure of about $\frac{1.12}{1600}$ of one per cent. of the power delivered.

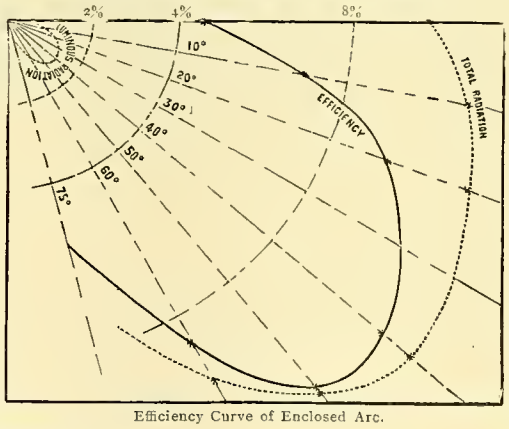
The cost of this pipe, which would weigh 800 tons, would be at present prices $16,000. If we should endeavor to deliver 2,700 horse power electrically to the same distance with the same efficiency of transmission at 10,000 volts it would require copper equivalent to forty-seven 0000 B. & S. wires, which would weigh 900,000 pounds and cost at 12 cents per pound $108,000, or 6½ times as much as the gas mains, and require transforming down after it was delivered before it could be utilized.

The above estimates allow nothing for leakage, which in gas mains is sometimes, though not necessarily, very large. According to James McGilchrist, the losses in leakage on the 2,000 miles of mains of the London Gas Light & Coke company, through which a maximum of 128,000,000 cubic feet per day is delivered, is only a fraction over five per cent.

The extreme cheapness of transmission of gas distribution enables the gas manufacturer to locate his generating plant where real estate, coal and water are cheap, and thus we find all of the gas plants in New York city located on the water front, whereas the principal electric light plants are placed on the most expensive land at such a distance from the water front that the hauling of coal and the disposal of the ashes costs one of the most favorably located of these plants 54 cents per ton on an aggregate of some 50,000 tons of coal per annum. Water for condensing or other purposes costs the largest consumers in New York 10 cents per 100 cubic feet, rendering it in most cases more economical to operate engines non-condensing than to run them condensing.



Efficiency Curve of Open Arc.



Efficiency Curve of Enclosed Arc.

FIG. 7. THE ENCLOSED ARC LIGHT.

1. *Transactions* American Institute of Electrical Engineers, 1895, p. 56.

1. "Gas vs. Electricity for Power Transmission." The *Engineering Magazine*, October and November, 1896.

These facts and the further fact that the gas manufacturer utilizes the majority of his generating plant continuously and at its maximum efficiency explain why on an investment of less than one-third he can accomplish essentially the same results more cheaply than can the electrical engineer.

The gas engineer, by reason of the facility of storage of his product, has practically no standby losses, and his total investment is constantly worked to nearly its maximum capacity. About the only part of the plant not so continuously employed is his distributing mains, for these are not employed to their fullest capacity except for an hour or two each day. He has avoided these inefficiencies over a portion of his system, however, by establishing distributing gas-holders at convenient centers so that the mains connecting these distributing tanks and the generating plant are continually employed; and only those radiating from these centers fall short of their full earning capacity.

The electrical engineer has appreciated the effect of the variable character of his load upon the earning capacity of his plant, and some of the most progressive engineers are convinced that it is economical to supplant the extra engines and dynamos necessary to take the peak of the load with storage batteries which cost as much as, if not more than, the apparatus displaced. But his transmission and distribution lines which cost more than those of the gas plant, as we have seen, are still utilized to their full extent but a small portion of the time. To obviate this the booster system with outlying storage battery centers of distribution has been suggested and in some cases employed, and this, it seems to me, is a step in the right direction. But we must go further. We must first of all materially reduce our enormous fixed charges, and next we must find some means of reducing our operating expenses, and accomplish both of these reforms without sacrifice of reliability of service.

Can we do better than to take a lesson from the gas engineer who has already solved in a measure these problems? I not only think we can profitably copy after him, but that we can possibly go him one better.

The first step would be to move our generating plants from the expensive sites now occupied and place them on cheaper land where fuel and water may be had most cheaply. If by this move we can save in our coal bill 54 cents on every ton of coal, costing, say, $2.50, we have at once made a material gain in operating expenses as well. If by adopting gaseous transmission we can cover a vastly increased area at the same cost, we have made another gain, and if by converting our coal into gas we are enabled to utilize coal that costs $1.00 or $1.50 per ton, whereas before we were paying $2.50, another material gain has been accomplished.

If by reason of the exceedingly cheap method of gas storage, which when employed on a large scale can be provided on an investment of but $1.50 per horse power hour capacity,[1] we can employ the real estate occupied, the buildings, apparatus, labor and administrative force to their fullest capacity, we have again reduced very materially both our fixed charges and our operating expenses.

We have seen that one gas company in London is supplying 70 square miles of territory through 2,000 miles of pipes with a leakage loss of but a fraction over five per cent., and that it has a straightaway transmission of 17 miles. The economical distribution of gas over areas much larger and to distances much greater than have ever been attempted electrically is therefore no longer an experiment, but an accomplished fact, and this fact becomes still more impressive when we realize that after paying all expenses of such transmission and the gas company's profit, we can buy that gas and produce more light from it through the intermediary of the gas engine and dynamo, at less expense, than we can buy electric light or than we could get from the same amount of gas burned in the ordinary way.

If these be facts they are very impressive, and should stimulate us to see how far we, as purveyors of electric power and light, can avail ourselves of them.

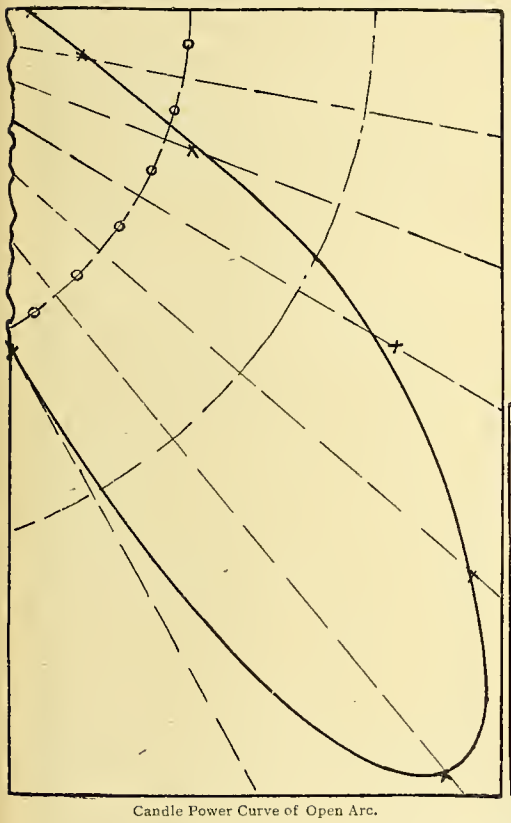
My own suggestion, expressed on several previous occasions, is this:

Locate a gas generating plant with regard to economy of land, fuel, etc., and install at this point a large gas holder, so that every dollar of investment at that point would have a maximum earning capacity. Taking advantage of the greater economy of gas over electrical transmission, transmit this gas to local centers of distribution. At these points smaller gas holders should be erected so as to enable the gas mains to be used to their maximum capacity. Gas engines would take the place of steam boilers and engines, less space would be required and standby losses entirely avoided. If our load line were such as to warrant the introduction of storage batteries, these would supplant the local gas storage and the real estate at this point, and dynamos, engines and labor would all be employed continuously to their best advantage. In fact, every dollar of investment from the gas generating plant to the electrical plant at the local distributing center, including the gas mains, would be employed to its best advantage, leaving only the distributing mains to be employed under a low load factor.

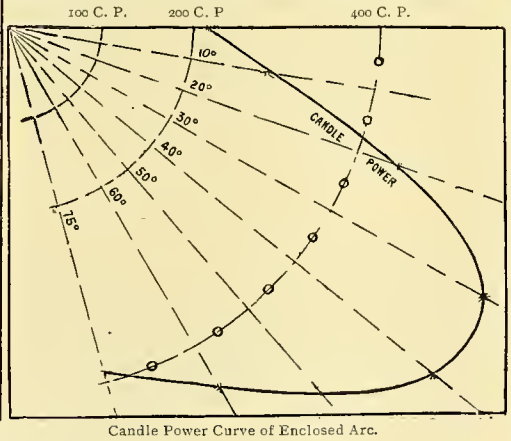
The economies in investment and in operating expenses thus accomplished would enable us to reduce the radii of distribution and thus to give the same service with less investment of copper or better service with the same investment, and to reach unsupplied territory at a profit not now accessible nor profitable by present methods.

I do not know just what proportion of the total cost of illuminating gas is due to the refinements of manufacture rendered necessary for the service it supplies, but it is undoubtedly large. Gas sufficiently clean for fuel purposes, without its high illuminating properties but of nearly equal calorific power, could doubtless be manufactored for considerably less than it costs the illuminating gas companies. The fact, too, that it could be distributed at very much higher pressures would make still further for economy.

As to the quality of the gas, it will pay to generate such as has a high calorific power if it is to be transmitted far. If to be generated locally and used on the spot, a low grade gas such as the Dowson gas, having a calorific power of about one-quarter that of ordinary 16 candle power gas, would undoubtedly be the most economical; but by reason of the greater volume required and of the greater frictional losses due to its greater specific gravity, such a gas would be less economical where long transmissions were involved than the richer and lighter gas produced at somewhat higher first cost.



Candle Power Curve of Open Arc.



Candle Power Curve of Enclosed Arc.

FIG. 8. THE ENCLOSED ARC LIGHT.

[1] A 500 foot holder would cost, erected in New York, about $700; a 1,000 foot holder, $900 to $1,000; a 150,000 foot holder, $15,000, and a 3,000,000 foot holder $180,000. Assuming that a gas engine requires 25 cubic feet per horse power hour, which is exceedingly liberal for the best types of modern gas engines, using gas of the average quality of our ordinary illuminating gas, the investment per horse power hour capacity for the largest sized tank named would be as given.

Economy of Electric Car Heaters.

Giving the figures published in the WESTERN ELECTRICIAN of December 26, 1896, showing the surprising result of a test made by Superintendent Jones of the South Chicago City Railway company, to determine the fuel cost of electrically heating his cars (shown to be less than one cent per car-hour in ordinary winter weather), the *Railroad Gazette* of February 5th comments as follows:

In most cases it would be unfair to take the results of the cost when figured on the basis of the fuel used as the true values. Where many cars are operated, the cost of the labor, fuel, wear, etc., is an important item and amounts to considerable.

We find in the *Proceedings* of the Engineers' Club of Philadelphia, for July, 1895, that James Christie gives the results of his investigation on the cost of car heating in the following words:

"I had occasion recently to investigate the cost of car heating by the current. The cars were the ordinary 16-foot bodies, each having four Burton heaters under the seats. The heaters are connected in series, each having a resistance of 35 ohms. These required for each car 3½ amperes of the 500 volt current. Allowing for the usual losses, this can be traced back to an equivalent of three horse power per car—at the station engine—or in the case under consideration, to 12 pounds of anthracite pea coal per car per hour at the boilers. The value of this fuel was 1.3 cents in the fire-room. Charging this item with its share of the general expense of labor and maintenance made the cost of heating the small cars about 1½ cents per car per hour."

Supposing that the car travels eight miles an hour and the cost of motive power is one cent a mile, then from the results obtained by Mr. Christie the cost of heating the car is about one-fifth of the cost to propel it. This result is apparently very low, but it will be observed that the cars were small and but four heaters were used. Houston and Kennelly, in their book on "Electric Street Railways," page 152, say that a fair average for the cost of producing a kilowatt-hour may be considered at 1½ cents, so that the expense of heating the cars by electricity during severe weather may be estimated roughly as 4½ cents an hour. If we take the above figure as reliable we find that the cost of electric energy required to heat a car during very cold weather would be about one-half as much as is required to propel it, providing the motive power per car mile was one cent. It is extremely difficult to obtain satisfactory figures bearing on this question, since there are many items entering into the computation that depend on the peculiar conditions of the individual roads. For instance, one company might strive to keep the average temperature of its cars at 70 degrees, while another might regard 45 degrees as the proper temperature, or one company might find it necessary to install new apparatus to perform the extra work, while another could use the machinery already in use without any additions.

English Telegraph Company "Called Down" in South America.

In many respects the governments of the South American republics may be open to criticism, but it is evident that one of them at least does not allow itself to be trifled with in the matter of discriminating telegraph rates. The following press dispatch from Buenos Ayres tells an interesting story:

The Western & Brazilian Telegraph company, an English concern, which has a monopoly of the telegraphic communication on the coast of Brazil until 1913, is connected with the city of Buenos Ayres by the lines of the River Plate Telegraph company of Montevideo. In order to harrass competition in the United States and Europe, an overcharge of 57 cents in gold a word beyond Buenos Ayres has been imposed on telegrams sent by way of Galveston to Brazil since 1892. Representations to the different governments concerned produced no effect until last June, when this government ordered the River Plate Telegraph company to stop collecting the overcharge in Argentine territory. Protests and proposals for an arrangement of the matter followed, all tending to elude the jurisdiction of Argentina. Last October the Argentine government gave the River Plate Telegraph company 24 hours' notice to comply with its decrees. The company replied, stating that it had obeyed and always would obey the orders of the government. This has since been found to be false, because on the occasion of the reduction of rates in January the overcharge on messages to Brazil figured along with the new tariffs submitted for approval according to law. The government sent a representative to the office of the River Plate Telegraph company to prove that a violation of its decrees was being insisted upon, and at 3 o'clock yesterday afternoon [January 30th] the government stopped the service here of that company in consequence of the evidence of insubordination. Since then the River Plate Telegraph company has inquired of the government on what terms the reopening of its office would be permitted, and the government has replied that only on unconditional surrender, without any reserve expressed or implied, will the company be allowed to resume business. This the company has failed to agree to, and consequently its office here will remain closed until such time as it sees fit to comply with the order of the government to make the tariff uniform, charging all the public alike and stopping the discriminating rate hitherto imposed on telegrams by way of Galveston.

The Ohio State University of Columbus, O., is trying to reach all classes of the citizens of the state, and desires that the educational advantages which it offers shall be known and appreciated not only by high-school students, but by the artisans, mechanics, shopmen, draughtsmen and all manufacturing people. It has arranged "short courses," the successful pursuit of one of which will benefit everyone who has any desire to improve his position in the world or to increase his earnings. A high-school education is not necessary for admission. Circulars giving information are gladly sent by the university on request.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 16,630.

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A COMMERCIAL museum has been established at Osaka, Japan, which is the commercial center of the Mikado's realm. Recent advices from the United States Consul at Osaka call special attention to the fact that one feature of this enterprise is a permanent exhibition of native and foreign productions, and the suggestion is made that American producers who are desirous of increasing their trade with Japan would do well to have agents represent them and their interests, secure space for exhibits and canvass for trade as they would in the home market. He adds that there is a large and constantly increasing demand for goods of American and European manufacture, and among those mentioned particularly are electrical appliances of all kinds. Reports from other sources indicate a desire on the part of the Japanese government to cultivate friendly trade relations with this country, but manufacturers who go to the expense of introducing their wares in Japan and establishing representation there should have some assurance that their apparatus will not be duplicated at once. They are entitled to some such protection as that afforded inventors under our patent system. At the present time articles of American manufacture are copied extensively in Japan.

INDEPENDENT telephone companies in Connecticut are looking for relief through legislative action that will compel the Bell interests to recognize them and make connections over their lines. On February 3d a bill was introduced in the house by Mr. Strong of Winchester, entitled "An Act to Prevent Discrimination by Railroad Companies in Regard to Telephones," providing that any railroad company shall, upon application, allow any person or corporation to place telephones in the office of its agents at the stations located in the cities or towns where the applicant may have an exchange in operation. Another measure was presented on the same day by Mr. Alvord of Winchester, entitled "An Act Concerning Telephone Companies," providing that no telephone exchange can discriminate against another telephone exchange, but must furnish the same service as it does to its other subscribers. Both bills were referred to the committee on judiciary. C. K. Hunt, manager of the Winsted Local Telephone Exchange of West Winsted, Conn., is author of both measures. He is anxious to secure co-operation of those who are interested in the proposed bill now before the Illinois Legislature upon the same subject. Anti-Bell companies in the West will be interested in following the movements of those engaged in the same cause in New England.

LAST year was a record breaker in the British Patent Office. The number of applications for patents filed in thot department during 1896 reached 30,165. This seems a very small number to anyone acquainted with the volume of business done in the Patent Office at Washington, but it was an increase of over 5,000 on the number of applications filed in the British Patent Office in 1895. An examination of the records shows that electricity was one of the branches in which there was increased activity. Improvements in methods of transportation seem to occupy considerable time in England. There were also several improvements and inventions in acetylene burners and in the methods of producing the gas.

It may also be mentioned in this connection that English inventors regard with favor the recent promulgation of a new law in the Russian Empire embodying important concessions to inventors, and the extension by Japan of the benefit of its patent laws to foreigners. The experience of some Americans in Japan has not increased their desire to promote commercial relations with that country, owing to the fact that imported machinery and devices of all kinds are boldly copied by native concerns. If protection can be secured to American inventors under the patent laws of Japan, this condition may be remedied, otherwise the interest of American manufacturers in Japanese trade will be short-lived.

LABOR organizations throughout the state have recommended the passage of a bill by the Illinois Legislature providing for vestibule car, as suggested in our last issue. Within the last three years such laws have been enacted in Michigan, Ohio, Minnesota and other neighboring states, and the result has been pronounced eminently satisfactory. Even the managers of the companies at first reluctant to undertake the additional expense of providing vestibules now admit that the change means increased efficiency as well as safety and comfort among the operators. It is asserted by the advocates of the proposed measure in this state that the trip sheets of the cross-town lines in Chicago show that in bad weather the number of motormen who fail to report for duty sometimes amounts to fully half the available list, and the safety of passengers has to be intrusted to extra men. The experience in all cities where the vestibule plan has been given a thorough trial is that the increased protection and comfort to the motormen enables a greater watchfulness and consequent protection to the passengers. On many lines in Chicago partial protection is afforded to motormen. These half-measure vestibules have glass fronts, but are open on both sides, exposing the motormen and passengers on the platforms to violent drafts. It is the purpose of the authors of the proposed vestibule law in this state to compel the uniform inclosure of the motor platforms on all sides, with the necessary openings for ingress and egress of passengers capable of being opened and closed at will. In ordinary weather of course it will not be necessary to keep the door on the rear platform closed, as this would greatly impair the efficiency of the service, but in such severe weather as that recently experienced every precaution should be taken for the protection of the employes.

Two prominent electrical engineers of acknowledged ability and high personal character have made a thorough examination of the fire-alarm boxes made by the Gamewell and United States companies for the city of Chicago under specifications of the fire department, and their conclusions confirm the impression that the contract should not have been awarded to the Gamewell company at the price named. The experts claim that the box made by the United States company for $45 was equal to that of the Gamewell company for which the city paid $100. The difference in the price named in the contract awarded the Gamewell company and the bid of the United States company for equally good apparatus is $4,125. This unnecessary expenditure of public funds was made upon the urgent and personal solicitation as well as the official recommendation of John P. Barrett, who advocated the selection of the Gamewell apparatus with vigor and audacity. The test of the experts, which was proposed by the representative of the United States company before the contract was awarded and at that time scornfully rejected by Barrett, was forced upon the department after the deal was closed by the *Chicago Record*, which notified all concerned in the affair that it proposed to investigate the matter thoroughly. The report of this commission is eminently fair and practical, as might reasonably be expected from men of their standing in the profession. Their conclusions carry with them the weight of conviction, and they will be accepted by the electrical fraternity and the community as final. The result places Barrett in an unenviable position. It is evident that he is not to be trusted with the administration of such an important office as that which he now holds, and that he should be deposed at once. He has already betrayed his superiors into a grave mistake through which a large sum of public funds has been squandered, and he should not be given an opportunity to repeat this performance. It is time to purge the city hall of the gang that surrounds Barrett and acts under his guidance, and the electrical fraternity should help along the good work.

AMERICAN manufacturers and merchants interested in foreign trade may derive some information from the discussion now taking place in Great Britain upon the "Berne Telegraphic Vocabulary." The policy of "patching" the 1894 vocabulary is generally condemned, and it is said that British merchants will have nothing to do with it unless radical changes are made. One writer says that he has a list of 661 words divided into 14 divisions, which are dangerous to transmit, as they are likely to cause trouble, and therefore should not have appeared in the vocabulary. Renewed and strenuous opposition is called for on the part of all concerned to the circular issued by the General Postoffice, London, in December, 1896, which is pronounced "a new illustration of the unskillful and bungling manner in which the International Bureau carries out the Budapest resolution." In face of the list just mentioned, the only unsuitable words found by Berne are stated to be 28, which are to be withdrawn. They range from A to W, and as there can be very few more after W, the correspondent can get little comfort from the information that they are to be informed if there are any more to be depleted. It is also suggested by Berne that the expressions "How-so," "How soon," "Mylord," "Mylady," are improper combinations and should not be used. These grotesque combinations are declared unsuitable, and as they are not words at all the wonder is expressed that they were not expunged and others substituted. Provision is also made by the Budapest conference that the words to be suggested to Berne for the new vocabulary must not contain "less than five" nor more than 10 letters! One correspondent expresses amusement that a minimum limitation of five-letter words should be approved at the conference. What objection would there be to a code of "ifs" and "ands" is asked, especially when such resuscitations as "acordelaba," "aereacion," "erbsstroh," etc., are suggested for the official vocabulary? The prospect of a limited and compulsory vocabulary, tending to put an end to the growth of business requirements, is viewed, the correspondent says, by the merchants with the deepest dissatisfaction. American telegraph officials and merchants engaged in foreign trade will be directly interested in the outcome of this discussion.

BARRETT CORNERED.

NO EXCUSE FOR EXPENDITURE OF $4,125 RECOMMENDED BY HIM.

Electrical Experts Pronounce Rejected Fire-alarm Boxes Equal to Higher Priced Apparatus Accepted by the City Electrician.

If there can be found to-day in the city of Chicago a man who does not regard John P. Barrett as a thoroughly discredited public official he should be produced at once, for Barrett is sorely in need of friends and supporters. After the developments of last week's investigation of the awarding of contracts for fire-alarm boxes, it would seem as if Barrett would immediately hand in his resignation if he has any regard for decency whatever. The investigation was forced upon the Fire Department by the *Chicago Record*, which had protested so vigorously against the recommendations in the superintendent's report, and which continued to demand a thorough test of the boxes by disinterested experts with so much persistence that Barrett was finally compelled to yield. Professor Stine, who was named by the *Record*, and Mr. Merrill, who acted at the request of Barrett, worked together and came to the same conclusions. This report places Barrett in the position of a man condemned by a judge of his own selection. Every pretence and pretext upon which the award was based is shown to be false by the declaration of the experts that the United States company's box was equal in every respect to the Gamewell box. This is a positive and emphatic repudiation of the claims set forth in Barrett's report, and it is signed by the man selected by Barrett to act upon the investigating commission as his representative. It is clearly proven that upon the recommendation of John P. Barrett the city of Chicago has made a contract for 75 fire-alarm boxes at $100 each, when apparatus equally good could have been procured for $55 less per box; in other words, the city agrees to pay $7,500 for an equipment that it could have purchased for $3,375 from an equally reliable company, thus squandering $4,125 of the people's money.

Result of Impartial Test.

The contract for the fire-alarm boxes for the city of Chicago, which has lead to an animated discussion of the methods employed by John P. Barrett in his official capacity, has been the subject of a careful examination during the last week by the *Chicago Record*. As noted in the last issue of this journal, the contract was awarded in spite of the warnings and protests of the *Record*, and in such a manner as to arouse suspicion that other motives than promoting the public good prompted this action. The matter was not dropped with the closing of the contract; an investigation by disinterested experts was demanded, and, under great pressure, the department was reluctantly compelled to have the boxes tested and the reports of Barrett and his subordinate, Mehren, made public. Professor W. M. Stine, director of the department of electrical engineering at the Armour Institute of Technology, was selected by the *Record* to make the test, and William H. Merrill, Jr., chief electrician of the electrical bureau of the National Board of Fire Underwriters, at the request of Barrett, consented to take part in the examination. It was agreed that the report should be made to Fire Marshal Swenie, the head of the department, and thus make the proceeding an official investigation.

The commission met on Friday afternoon, February 5th, and examined J. F. Mehren, superintendent of the city repair shops, who had tested the boxes for the city and had been permitted to pass upon their relative merits, although one of the most important features of the Gamewell box was a device invented by him. James W. Johnson, the agent for the United States company, explained the conditions upon which he was compelled to compete with the Gamewell apparatus. The test of the boxes was conducted at Armour Institute the following day, and the result of the examination is presented in the following report, which is signed by Professor Stine and Mr. Merrill:

We beg to submit the following report of our findings on these boxes, in which the device of the United States Fire & Police Telegraph company is designated as box "A" and the device of the Police Telephone & Signal company is designated as box "B."

Box "A."—This is essentially a plain sector box, designed for operation on a normally closed circuit. When the lever is pulled for an alarm a heavy, coiled spring is wound up, which, on being released actuates the sector, and this, through a suitable train of gears, operates a break wheel, which, by engaging a lever arm alternately opens and closes the circuit, and thus the appropriate signal is repeatedly transmitted. Coupled with this is a signal key and an indicating magnet with bell attached.

We do not consider that this box complies with your specifications or is suitable for use as designed, in the following particulars:

1. The contacts for shunting out and thus protecting the box mechanism are inefficient. We find they are fitted with plain metallic surfaces, which come in simple contact with each other. Such contacts are liable to be affected by corrosive coatings which may greatly increase their electrical resistance. For this reason wiping contacts, in which the surfaces are rubbed together when pressure is applied to close the circuit, are preferable.

2. The connections for the box mechanism are not so arranged that on the operation of the shunt dangerous currents would be prevented from passing through the transmitting contacts. These connections were not found to be placed in series, so as to introduce a sufficiently high resistance into the circuit it is necessary to protect. We have seen a plan showing these connections properly made in series, which, if carried out, would remedy this defect.

3. The inner door is provided only with a key lock. This door is depended upon to depress a spring contact closing the protecting shunt. The pressure of the spring therefore operates to open the door. If, through carelessness, the door is closed without being locked, the spring will open it and the box will not respond when pulled. The door should be supplied with a spring catch as well as a lock.

4. The screws designed to secure the connecting wires are not substantially made. The head of one of them was easily twisted off with a small screw driver.

Box "B."—This box was essentially similar to box "A," except that it employed a cut-out in place of a shunt for protecting its mechanism. We do not consider that this box complies with the spirit of your specifications, or that it is suitable for use as designed, in the following particulars:

1. The signaling contacts are normally open. Dust and insulating coatings may deposit on these contacts to such an extent as to prevent the closing of the circuit when the box is operated. The protecting coverings for the mechanism are not dust-proof, and do not remove danger from this source.

2 The cut-out contacts are sufficiently light to be fused by foreign currents similarly to the signaling contacts of box "A."

3. The construction of the commutator and the plug is such as to allow the closing of the box, with all its mechanism out of circuit and inoperative. This serious defect could be remedied by reconstructing this similarly to the one shown in box "A."

4. This box, when pulled, does not indicate by the striking of its bell that the alarm is being properly transmitted, and an inferior grade of insulation is used on its connecting wires.

Defects common to both of these boxes are found as follows:

1. Altogether too many screw contacts are depended upon for making electrical connections.

2. The carrying capacity of parts of the circuits of both boxes is too small.

3. Some of the more important mechanical parts depend solely upon small set screws for holding them in place.

Neither of the boxes was supplied with devices intended to shunt to ground high potentials or to open the circuit in case of abnormal currents, but we assume that when these boxes are connected to aerial wires such protective devices are installed.

We believe that many of the defects noted in the foregoing are critical, and you, of course, agree that all possible refinements of design and construction are essential to mechanism of this kind, upon the invariably successful operation of which the safety of life and property depends.

If any comparison is needed between these two boxes, we give it as our opinion that their comparative merits and defects are about equal.

This report completely sustains the charge of favoritism on the part of Barrett, not to put a more uncharitable construction upon his course in this matter. The experts conclude their report with the statement that the boxes' "comparative merits and defects are about equal." This, of itself, is sufficient to condemn the action of the department in paying $4,125 more for the Gamewell boxes than the price at which the United States boxes were offered. It should be borne in mind in this connection that the box submitted for examination was hastily constructed by the United States company; that it was a special design to meet the requirements of the specifications which made it necessary to follow the design of the Gamewell box, and that the objections raised by the experts were upon points in which it departed from its regular style of construction to comply with the requirements of the city specifications. The same objections are made by the experts to the Gamewell box, and in one important particular they institute a direct comparison, saying "this serious defect [in the Gamewell box] could be remedied by reconstructing this similarly to the one shown in box 'A'" [United States type].

Another point that should not be overlooked is that the experts agree that the style of box adopted as a standard by Barrett does not comply with the spirit of the city's specifications, and that it is not suitable for use as designed.

Barrett's Official Advocacy of Gamewell Apparatus.

Barrett's report to his superior, Fire Marshal Swenie, is an interesting document, not because of any technical value or for the information that it contains, but merely as an illustration of the audacity of the writer in placing such an official document upon file. He says:

From Mr. Mehren's description of the United States box it must be apparent to anyone familiar with the fire-alarm service that it is an unsafe machine to employ for that purpose. As you are aware, the fire-alarm system in this city has grown from a comparatively small beginning, 30 years ago, until it is now the largest in the world. It has been the aim of this branch of the department during all these years to keep pace with the march of electrical improvement, and to at all times equip itself with the very best, safest and most speedy means of accomplishing the ends for which it was established—viz., the communication, from any part of the city, of a prompt, definite and universal alarm of fire. Until within a comparatively recent period the only menace to the security of the apparatus entering into this service was lightning, and ample provision has always been made against that danger.

Of late years, however, a more serious menace has arisen in the large and constantly increasing number of stations, lights and trolley plants. It has been no easy task to devise a simple, and, at the same time, effective protection for street boxes and engine-house apparatus against the tremendously destructive power of these two agencies, when the seemingly inevitable contact between their lines and those of the fire-alarm service comes. Such a device has, however, been produced, and has been incorporated into all our later-day purchases, and in boxes of older date, as rapidly as circumstances would permit.

I would not for myself accept as a gift any street box not possessing these or comparatively similar devices. That the United States company's box does not possess these devices or their equivalents, leaving out of the account its mechanical short-comings, is clearly stated in Mr. Mehren's report—and in this he is sustained by my own observations.

Where so much is at stake, including life as well as property, safety should be considered above price. The citizen who is called upon to communicate the dread announcement of fire, whether for himself or his neighbor, should have the assurance that the best means that the state of art, regardless of cost, can produce, is at his disposal for that purpose.

I am, therefore, constrained to recommend that the bid of the Police Telephone & Signal company be accepted, and that the bid of the United States company be rejected.

This document, read in the light of subsequent developments, is really discreditable to the department. What it pronounces "an unsafe machine" is declared by Mr. Merrill and Professor Stine to be as efficient and reliable as the apparatus at present employed. Instead of attempting to keep pace with the improvements in this class of apparatus, it has been the constant aim of Barrett and his associates to retard progress by preventing competition. No better evidence could be desired than that furnished by the specifications under which bids for apparatus are required. Barrett says he would not accept the United States box as a gift, yet Professor Stine and Mr. Merrill say that it is just as good as the Gamewell box. His entire report is a series of misrepresentations. The appeal to prejudice and fear is intended to mislead the public, but the investigation has shown that there need be no apprehension on this ground. Barrett's grand-stand play falls rather flat when read in connection with the report of the *Record's* commission.

The "Record" Reviews the Situation.

The *Record* on February 9th published the following significant editorial, summing up the situation:

According to the report returned by the experts who at the request of the *Record* have been examining sample fire-alarm boxes, Chicago is paying $100 for an article when it could have another quite as good for $45. The men who gave these opinions on boxes submitted for inspection are thoroughly familiar with the work and speak as impartial critics. Prof. Wilbur M. Stine, director of the department of electrical engineering in the Armour Institute of Technology, and William H. Merrill, chief electrician of the electrical bureau of the National Board of Underwriters, submit that the $100 box made by the Police Telephone & Signal company is no

better than the $45 box made by the United States Fire & Police Telegraph company. "Their comparative merits and defects are about equal," says the report.

These opinions, which are detailed and make specific mention of the points upon which the judgment is based, are recommended to the consideration of the public in connection with Superintendent Barrett's declaration in favor of the $100 box. It is not to be supposed that Superintendent Barrett's former interest in the more expensive contrivance has anything to do with his recommendation that it be kept in use. He asserts with conviction that the $45 box is an "unsafe machine." Notwithstanding that in the opinion of two experts there is no reason why one fire-alarm box should not be as serviceable and safe as the other. Prof. Barrett insists upon using the box which costs the taxpayer most and in which he was at one time personally interested.

The taxpayer can but form his own inferences as to the policy which recommends a heavy expenditure for an end which could be secured as well for less than half the amount.

Standard Railroad Cars Electrically Operated in California.

It is not alone in the East and Middle West that the application of the electric motor to steam railroad conditions has been favorably considered and adopted, for a very interesting adaptation of the electric motor has recently been made on a railroad in California. The California Railway company operates a short line of road some three miles in length, which runs from the junction of the Southern Pacific railroad to Leona Heights, passing on the way Mills Seminary, an educational institution for women. The road serves Alameda and Fruitvale, which are both located just across San Francisco Bay opposite San Francisco.

The cars used are standard steam railroad cars. The motor cars of the trains, one of which is shown in Fig. 1, are composite baggage and passenger cars. Motor car No. 11, as illustrated, is vestibuled at each end and carries on each hood an electric headlight. It takes current from an overhead wire by two trolleys, one of which only is in contact during operation. Each motor car is fitted with an automatic air pump to operate the brakes and the chime whistles, of which there are two, one on each hood. The motor equipments consist of four "G E 1,000" motors, two mounted upon each truck. The controllers are of the K type and are provided, of course, with a magnetic blowout. Each car is provided with automatic circuit breakers and resistances, and the interior is lighted by incandescent lamps in groups of three. Fig. 2 represents the interior of car No. 11, showing the position of the controller and the motorman as seen through the door of the baggage compartment.

Motor car No. 21, which is shown coupled to its train in Fig. 3, is also a composite car and is similarly equipped so far as its electrical apparatus is concerned. It is not vestibuled, however, and was one of the first to receive its electrical equipment.

The track is of standard steam railroad construction, bonded for the return. The overhead line is suspended from iron brackets swung from round poles for part of the way; for the balance of distance it is suspended from span wires. The general character of the equipment of this road is similar to that in operation on the New York, New Haven & Hartford, with the exception of the motors; and it will be recalled that the cars of this latter line and their equipment served as models, both in the design of the car itself and the arrangement of the motors, for the locomotives designed by the late D. L. Barnes.

The General Electric company, which carried out the equipment of the California Railway company through its Pacific Coast office, will equip another locomotive for use on the Alameda and Fruitvale line, using, however, two or four "G E 2,000" motors instead of "G E 1,000" motors, as on the other cars.

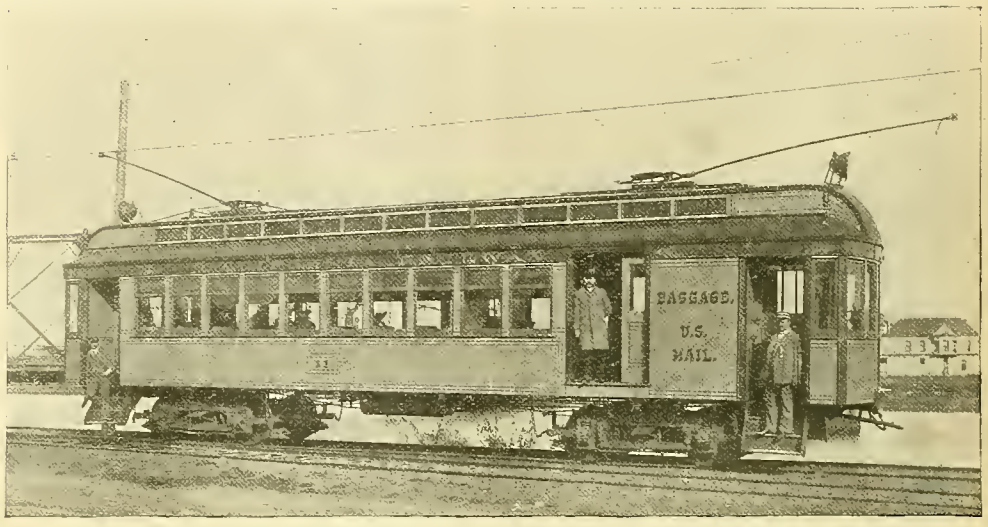


FIG. 1. STANDARD RAILROAD CARS ELECTRICALLY OPERATED IN CALIFORNIA.

FIG. 3. STANDARD RAILROAD CARS ELECTRICALLY OPERATED IN CALIFORNIA.

Progress in Electrical Engineering.[1]

By Alfred Hay.

Probably no other branch of applied science has ever advanced with strides as rapid as those which have characterized the progress of electrical engineering. To some extent this may be accounted for by the fact that whereas most other branches of industry had their origin at a remote date of human industry, electrical engineering came into existence at a time when the spirit of scientific inquiry had already become a dominant factor in shaping human progress. It is, like many another industry of recent date, the direct result of scientific research. Electrical engineering without a scientific foundation is an anomaly, an impossibility.

To an outsider, the marvelous growth of the new industry is somewhat difficult to realize. The time is not far back when dynamos were regarded with curiosity, and an arc light excited a feeling of wonder. The extraordinarily rapid development of electric lighting does not seem to have been brought home to the mind of the general public. Large central stations for electric lighting and power distribution are a growth so recent that we have not yet ceased being told that "electricity is in its infancy," a saying repeated so often that it is apt to excite a feeling somewhat akin to nausea. At this time of day, indeed, when millions of pounds are invested in costly electrical plant it seems somewhat late to be made the recipient of this startling piece of information. Nevertheless, the saying has a moral of its own; it indicates a development so rapid that the mind of the general public has been unable to keep pace with it. What was new some three or four years ago is pretty well matter of ancient history to-day.

In surveying the rapid growth of the electrical industry, it may be said that development has proceeded along certain well-defined lines, and that along many of these a very advanced state has been reached. Early in the century we had the discovery of the electric arc, which first rendered electric lighting a possibility. Then came the development of the dynamo, by means of which the production of currents on a commercial scale was rendered possible; and the introduction of the incandescent lamp solved the difficulty of "distributing" the electric light. For a time, however, the high hopes which had been entertained regarding electric lighting were doomed to disappointment. A large number of companies, formed somewhat prematurely, came to an untimely end and a reaction set in. Meanwhile, those who were capable of seeing somewhat more clearly than the promoters of ill-starred companies did not despair of the problem they had taken in hand. During the years of comparative inactivity which intervened between the first spasmodic efforts to introduce the electric light as a general illuminant and the subsequent successful solution of the problem, the dynamo received such careful study and attention as transformed it from a somewhat crude optician's toy into a substantial engineering structure perfect in every detail, and possessed of an efficiency which few other machines could boast. The calamities which overtook the earlier companies cannot, therefore, be looked upon as having produced wholly undesirable results. They prevented the introduction of machinery which eventually would only have retarded the progress of electrical engineering.

The last decade has witnessed the establishment of central stations in all the more important towns throughout the United Kingdom. Something still remains to be done (in some towns, at any rate) toward rendering the supply pressure between the distributing mains somewhat more constant than it is at present. The price charged per supply unit will also probably be reduced when further advances have been made in dealing with the inconvenience caused by the peaky nature of the load curve. It is to be hoped that with a more general use of electric motors this latter difficulty will be to a large extent overcome.

Electric traction and the applications of electricity to chemical processes have up to the present not received in this country the full share of attention which they seem to merit, and during the next few years we shall probably witness considerable progress in these directions. The same remarks apply to power distribution by multiphase alternate-current motors.

It is easier to look back upon the past than to peer into the future. Yet one cannot but help looking forward to many important changes which future inventions and discoveries will work upon present-day practice. Looming large above all other problems is the one which is already engaging the attention of many able workers —the problem of "electricity direct from coal." It is probably rash to say that the day is not far distant when electrical energy will be got by the direct oxidation of carbon, and with an efficiency of conversion which will altogether outstrip all present-day indirect methods, in spite of all the sensational announcements of too-sanguine inventors and the jubilant articles singing their praises (somewhat prematurely) in popular monthlies. But although we have not yet learnt how to do it, we have, at any rate, gained some knowledge as to how not to do it, and future workers will at least have some beacon lights to guide them in their arduous task. The quest is a difficult one, but the prize is high, and we can only hope that there will be found a Sir Galahad to whose enraptured gaze will be revealed the secret of what, when found, will undoubtedly prove one of the greatest achievements of modern science.

1. From the *Electrical Engineer*, London.

Edison Seeking to Improve the Fluoroscope.

Eastern papers report that Thomas A. Edison is endeavoring to find something superior to the present material used for the lining of the fluoroscope, in order to increase the efficiency of that instrument for direct examination with the X-ray. This statement is attributed to the inventor himself:

Mr. Edison first purchased in this country and Europe all the different chemicals known or sold in the trade which he did not already possess. These were all tried in the fluoroscope, and only one was equal in sensitiveness to tungstate of silicium. Since then, however, Mr.

FIG. 2. STANDARD RAILROAD CARS ELECTRICALLY OPERATED IN CALIFORNIA.

Edison's chemists have been making chemical combinations not procurable elsewhere. Thirty new substances a day have been the average product. These have been subjected to the X-ray and their power measured. Mr. Edison has found one chemical which is more sensitive to the X-ray than any heretofore known. He will keep on in his work, however, until there is little hope of finding anything better, although he says that the chances of discovery can never be exhausted, the possible chemical combinations running up into the hundreds of millions.

Should Mr. Edison succeed in finding what he is after, there is no doubt that the fluoroscope will be an instrument of great value to the surgeon, for by means of it he will be enabled to make an accurate diagnosis of the internal organs of man.

Library Lamp for McKinley.

There is on exhibition in a jewelry store in La Crosse, Wis., a handsome library lamp fitted with the patent

LIBRARY LAMP FOR M'KINLEY.

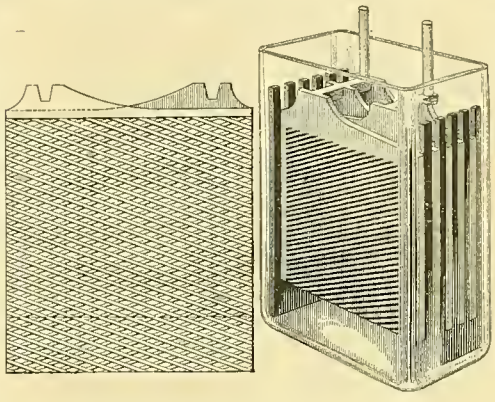
Espersen adjustable shade. This shade is manufactured by the Pacific Electric company of La Crosse, and the lamp mentioned is to be presented to Major McKinley by that company. The presentation will be made by Mr. Kurtz, president of the Gillian Manufacturing company of Canton, and thereafter the man who is so shortly to become the president of the United States can throw light on problems of state by adjusting his Espersen shade. The accompanying illustration shows the type of lamp which is to be given to the president-elect. A beautiful silver cupid upholds the lamp, and the shade is perfectly adjustable, permitting the light to be directed in any direction.

A New Storage Battery.

In the accompanying illustrations are shown the type of storage battery recently put on the market by the New York Accumulator & Electric company of 150 Nassau street, New York. The battery, in itself, has certain novel and valuable features, which, it is claimed, should readily commend it to intending purchasers, and give it a prominent place among its many competitors.

The battery plate, Fig. 1, consists of a single integral piece of pure lead. It is an open work, ribbed and grooved plate, without any border. The ribs of one side of the plate cross those of the other and are bodily, and hence electrically, joined to them. Where strength and durability are first considerations, the plates are made heavier, every tenth rib being made thicker and the adjoining grooves wider. The plate is made either by casting in a mold or else by pressing, rolling or sawing it out of a piece of pure rolled sheet lead. It will be readily seen that a plate so constructed has greater strength and a larger exposed surface for a given weight than has any other form of ribbed plate.

The battery, Fig. 2, is of the Plante type, the active material being formed directly from the lead itself by electro-chemical action. The formation is very fine-grained in texture, and compact and adherent. The average capacity ranges from three to five ampere hours



FIGS. 1 AND 2. A NEW STORAGE BATTERY.

per pound of element, though a higher capacity can readily be attained where excessive lightness of plate is desired. The internal resistance of the cell is very low. The insulation of the plates is said to be so perfect that a cell has retained the greatest part of its charge for a period of over seven months. The battery will withstand an excessive charge and discharge rate without sustaining injury. For some uses the positive plates are especially protected by perforated sheets of insulating material secured close to the plate by means of soft rubber bands or otherwise. This prevents scaling and bridging. The battery has been subjected to severe and repeated tests for a period of nearly eighteen months, and doubtless will uphold all the claims made for it. This battery is manufactured under non-infringing individual patents, lately issued, owned by the company, which guarantees to purchasers full protection against litigation.

Martini's Patent Lag and Pipe Wrench.

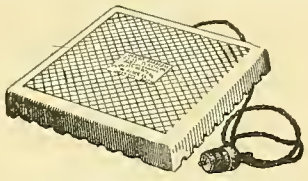
The lag and pipe wrench illustrated herewith is a new departure in the line of automatic wrenches and has a number of desirable features. The movable jaw at the top causes it to tighten as the pressure on the handle is increased. It will not slip, takes hold and lets go suddenly and is always ready. In the operation of this wrench there is no lost motion, and no time is lost in adjusting. The wrench is made of drop forged steel, with jaws of the best tool steel, hardened and tempered, which can be replaced when necessary at a very little expense.

This specialty has had the approval of practical men familiar with this class of tools, and is already being extensively used. It promises to be in great demand, as it accomplishes all the purposes of a much more complicated and expensive tool. The Electric Appliance company, which has undertaken to put this wrench on the market, has the exclusive agency.

The West End company of Boston has just placed an order with the Westinghouse company for 450 car motors.

New Electric Foot Warmer.

The Detroit Electric Heating company of 132 Shelby street, Detroit, Mich., is keeping abreast of the times in bringing out a number of new and useful improvements. One of these is an improved foot warmer that can be used in a variety of ways. It is 10 inches square and only 1½ inches thick, with rounded corners and a flat, smooth surface that gives off an agreeable heat, that is just right; never too hot or too cold. In one position it can be used as a foot-stool, being supported by folding legs at a convenient angle, and can be easily moved about as desired. It may be connected to any lamp socket by cord and plug, using only 50 watts. The legs may be quickly folded and held snugly on the under side by an ingenious arrangement, so that the warmer will lay flat on the floor, and



NEW ELECTRIC FOOT WARMER.

a person can stand upon it to work at a desk or counter. In this position it is useful in a motorman's vestibule, or even on the floor about the seats of a car in severe weather. It can be used for many purposes where a gentle but steady heat is required and is valuable in hospitals, as it can be placed at the feet of a sick person in bed, and be relied upon to give the proper heat for any length of time. This device, shown in the cut, is safe, economical and durable, and is supplied with japan, bronze or nickel finish.

Evils of Overcapitalization.

[From the *Chicago Record.*]

The evils of overcapitalization by issues of stock by corporations are so many and obvious that it is difficult to see why they have not been more effectively provided against in the different states. The "L" roads of this city furnish a most effective object lesson, if any were needed on this subject. The Alley, the Lake Street and the Metropolitan elevated roads in turn have had to pass the inevitable crisis of assignment or reorganization, as it was simply impossible for them to pay interest on the bonds originally issued. These roads might have and undoubtedly would have paid fair interest on their real cost of construction, but it was out of the question for them to earn interest on their enormous overcapitalization.

It is directly against such evils as brought the three roads mentioned to grief that a bill has been introduced in the Michigan Legislature, in accordance with a recommendation in Governor Pingree's inaugural address, to prevent fraudulent issue of stock by corporations. The bill provides that no corporation shall issue stock as fully paid unless such payment has actually been made in cash or property, and, if the latter, an inventory thereof shall be made, and, with the estimate of its value, filed with the county clerk. It is also provided that every certificate of stock must show on its face whether or not it is fully paid, and every dollar of stock not fully paid shall be liable, as a partner, for all debts of the corporation until so paid. No bonds are to be issued by

MARTINI'S PATENT LAG AND PIPE WRENCH.

any corporation except at their par value, nor issued before the subscribed stock has been fully paid, nor for a greater amount than the value of paid-up stock.

These provisions are in the main but simple honesty enforced upon corporations, and require from them nothing more than any discreet person, as a prospective investor, would require of a holder of such stock, were it possible. They are necessary for the protection of the public, and the passage of some such bill is greatly needed in this state.

Tale of Two Cities.

[From the *Chicago Chronicle.*]

Trailers are not what Chicago needs. They are uncomfortable and dangerous. They are out of date and a makeshift. Long, heavy, well-built single cars manned by intelligent and polite employes should be run at intervals of not more than two minutes. They should be lighted by electricity and heated by the same means.

[From the *New York Herald.*]

Now that the underground trolley system is to be introduced on several of the surface lines, let us pray that the power will not be furnished in jerks, as seems to be the method on the cable cars.

COMMUNICATION.

Static Device for Detecting Grounds.

To the Editor of the WESTERN ELECTRICIAN:

At the last meeting of the Northwestern Electrical association, H. C. Wirt of the General Electric company recommended the use of a static instrument as a means of detecting grounds, and stated that such an instrument would be on the market in six weeks. Allow me to call your attention to the fact that such an instrument has been on the market for two years and that its use is fully covered by United States patent No. 544,275, dated February 11, 1896, granted to me. JOHN F. KELLY.

Pittsfield, Mass., February 1, 1897.

Street Railways in Massachusetts.

The report of the Massachusets railroad commissioners relating to street railways was submitted to the Legislature of that state on February 5th. There was added last year to the mileage of the Massachusetts companies 175,528 miles of street railway line, and 23,232 miles of second main track, making 198,760 miles of new or additional main track. There have also been built or added 14,237 miles of side track, making a total addition of 212,997 miles of track, reckoned as single track. The Massachusetts companies now own 1,083,516 miles of street railway line, 193,229 miles of second main track, and 91,502 miles of side track, making the total length of track owned 1,368,247 miles. The average cost of the street railways of the state per mile of main track was $46,041.38. The total income of the companies from all sources for the year was $14,900,914; total expenditures, $14,423,012; net balance, $477,929; cash dividends declared, $2,802,846.50, an increase of $196,652 over the previous year. Forty-three out of the 83 companies paid from 1¼ to 10½ per cent., and 40 companies, new and old, declared and paid no dividends. The total number of passengers carried was 282,358,943, an increase of 32,564,635 over the previous year. The number of passengers carried on the street railways exceeded the number carried on the steam railroads of the state by 180,729,892.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 6.—On Thursday the Rapid Transit Commission met in executive session and adopted the underground plan of rapid transit submitted by Mr. Parsons, chief engineer of the commission, excluding the section below the city hall to the South Ferry. Secretary Delafield said that the reason the southern end of Broadway had been cut out of the plan was that the commission felt that, as long as there was the slightest objection on the part of any of the property owners against the tunnel scheme in that section, it would not adopt it. Mr. Delafield added that if the property holders south of the city hall wanted that section of the road built they would have to hurry and present their acquiesence within the next two weeks, for after that time there would probably be no chance for making changes in the plans.

Another effort is being made at Albany to reduce the exorbitant telephone charges in this state. Senator Brush is the father of the measure. The bill provides that the attorney-general, the state controller and the state engineer shall constitute a commission to investigate the many complaints of overcharges for telephone service, and to propose remedial legislation. To prevent groundless complaints from being made, the expense of investigations where charges are not proved must be borne by the complainant. The bill, after its introduction, was referred to the finance committee of the Senate, as it carries an appropriation. It would otherwise go to the committee on miscellaneous corporations. At a public hearing on Tuesday Frank S. Gardner, secretary of the New York Board of Trade; G. Waldo Smith, president of the Wholesale Grocers' association, and Mr. Franz, of the Brooklyn Druggists' association, appeared in favor of the bill. Mr. Smith made a strong speech in favor of a reduction of telephone charges. He said that 71 organizations in all parts of New York state had passed resolutions asking for some sort of legislation which would relieve them from excessive telephone charges. Comparing the charges in New York and foreign cities, he stated that telephone service which cost $240 in New York city could be obtained in Berlin for $100 and in London for $85 a year. Secretary Gardner of the New York Board of Trade expressed the opinion that this measure, if passed, would produce the results desired as well as any other measure, as he believed the state officers named in it could be depended upon to make an impartial investigation. He was followed by Mr. Franz, who uttered the protest of the druggists of Brooklyn against exorbitant charges for telephone service. The hearing was closed, and the committee in executive session decided to report the bill to the Senate, in order that it may be referred to the committee on miscellaneous corporations, with the understanding that that committee shall give another hearing on the bill on Thursday afternoon, February 11th.

The United States & Hayti Telegraph & Cable company of this city has filed with the secretary of state, at Albany, a certificate of payment of one-half of its capital stock of $1,800,000. The certificate is signed by George Clapperton, Charles E. Merritt, Albert Beck and Edward C. Platt.

A week ago the *Tribune*, with commendable enterprise, issued a "Greater New York" edition of 76 pages. In the "Industrial Supplement" the professional, commercial and manufacturing life of the city was reviewed at length in a series of articles, setting forth the greatness of New York. Two pages were devoted to the "World of Electricity," and this department has that in it that excites the joyous smile in the electrical man who might otherwise be bored by statistics impressive but monotonous. For instance, how delightful, at the outset, to cite "that distinguished authority on electrical science, W. J. Johnston," to controvert the popular fallacy that "electricity is still in its infancy." No one could ask for anything funnier than that. And then, the attentive reader, on looking farther, will discover a little list of dates of "first things" in electrical development, "compiled from reliable statistics in the possession of the publishers of the *Electrical World*," in which, among such entries as "First public arc light exhibition," "First commercial incandescent plant," and so on, will be found the important statement, "An electrical journal established, 1874." Taken separately or in conjunction, these two samples of the electrical information given to the readers of the *Tribune* cannot but be highly amusing to all acquainted with electrical men or electrical journals. M. S.

Milwaukee, Wis.

MILWAUKEE, February 6.—The municipal lighting project, which a short time ago seemed to be upon the point of success, has received a decided setback in "the house of its friends," as the Common Council might have been called. The Republican Party was pledged at the last city election to municipal lighting and the Common Council is a Republican body. At a late regular meeting of the council, however, the resolution adopted some time ago to set aside the premiums received for city bonds, which premiums amounted to more than $60,000, for starting a municipal lighting plant, was reconsidered, and in its place was adopted a resolution favoring the passage by the Legislature of a law authorizing the city to issue bonds for the erection of a municipal lighting plant. This is a setback of the project, in that it takes away the funds which had been provided for the purchase of a site for a municipal lighting plant and leaves the whole result contingent upon the action of the Legislature. It was by a vote of more than two to one that the council set aside the resolution providing for the use of premiums on bonds for a lighting plant, and it decided to divert the money to the use of the Fire Department and to other purposes. Only three aldermen voted against the resolution calling for legislation by which the city can issue bonds for the purpose of building a lighting plant, but the friends of municipal lighting declare that the street railway company, which has the street lighting contract, will make its fight in the Legislature, where it will have numerous friends, to say nothing of a strong lobby. However, President Rauschenberger of the Common Council declares that as the Republican city administration is committed to the cause of municipal lighting, it must carry out its pledges or suffer the consequences at the next election.

The street railway companies of the state now pay into the public treasury a certain percentage of their earnings in lieu of taxes. Milwaukee aldermen declare that under this arrangement the city gets only a small percentage of what the street railway company should pay, especially as the company does not have to pay anything in the way of taxes upon its lighting system or upon the income therefrom. The Common Council has, therefore, approved a bill for submission to the Legislature for the purpose of doing away with the present system. The bill provides for the taxation of all street railway companies, electric lighting companies and gas companies in the ordinary way—assessment and taxation of the real and personal property. The bill provides that the officers of street railway companies shall upon demand make out every June a sworn statement of the different pieces of land which it owns, of the number of miles of track which it operates, of the number of cars which it possesses, and of all the other personal property which it owns. It is made the duty of the board of assessment or of the assessor of the district in which this property is located to assess it as an entirety in the assessment district in which may be the general offices of the company. After this assessment in entirety is made, the Board of Review, in cases in which the property is contained in several assessment districts of the same town or city, shall divide it among them according to the value of the different parcels of real estate and the number of miles of track in the respective districts. In case the company makes no return, the assessor or board of assessment is empowered to examine the company's property and assess it, with authority to examine the company's books and to put the officers of the company under oath with regard to the value of their property. If any company willfully neglects or refuses to furnish such a statement as the proposed law calls for, the officers render themselves liable to a fine of not more than $1,000 or imprisonment for not more than six months, or both fine and imprisonment. It is expressly provided in the bill that nothing in its provisions shall exempt the company from the payment of licenses upon its cars or the payment of special assessments upon its real estate for public improvements.

Assemblyman Eaton has introduced into the Legislature a bill providing for the taxation of the street railway companies by raising the percentage of their earnings which, under the present law, they are compelled to pay into the public treasury. The present rate is one per cent. upon gross receipts up to $250,000, 1½ per cent. upon the next $250,000 and two per cent. upon all gross earnings in excess of $500,000. Mr. Eaton's bill increases the rates to 1½, two and four per cent. He says that under the ordinary system of taxation the Milwaukee company would have to pay about $60,000 into the city treasury, while the present law cuts its taxes down to about $21,000. His bill, he estimates, will require the company to pay about $29,000 into the city treasury.

In the Common Council a resolution has been introduced for the purpose of putting a stop to the litigation between the city and the Milwaukee Electric Railway & Lighting company over the four-cent fare ordinance. The resolution recites that the situation shows that the city has nothing to expect from the litigation except enormous expense and indefinite delay, and it directs that the committees on judiciary and railroads see to it that the suit is dismissed and that all further efforts to enforce the four-cent fare ordinance be discontinued. The resolution has been referred to the two committees named in it. It is apparent that the street railway people are stronger in the Common Council than they were a few months ago, and the resolution may be adopted. Assistant City Attorney Van Wyck, however, says that the adoption of the resolution will place the city in a disadvantageous position. It was the company that determined to resist the four-cent fare ordinance, which began the litigation, and if the city allows the case to go by default the company could take judgment in accordance with its petition, and this judgment would finally determine the questions at issue in the suit.

The South Milwaukee crossing war between the Milwaukee, Racine & Kenosha Railway company and the Chicago & Northwestern Railway company has plunged the latter road into a perfect sea of litigation. All the electric railway men engaged in the affair, from President Matthew Slush and Attorney Kearney down to the two score laborers who attempted to put in the crossing over the Northwestern tracks, have sued the Northwestern company for damages. In guarding the crossing the Northwestern company's employes placed a nozzle upon one of the steamcocks of a locomotive and caused the engine to run back and forth over the disputed crossing, discharging steam upon all who might be within reach. More than forty of the electric railway people claim damages ranging from $15,000 down.

Peter Van Hagen, chief electrician of the Menominee street railway system, was fatally injured the other day. He was standing at the top of the high trolley wagon repairing a live wire, when he received a shock which rendered him unconscious. He tumbled off the wagon, struck a wheel and landed on his head, breaking his collar bone and crushing his skull.

The Belle City Railway company of Racine may come out of its present troubles all right. Outside of its bonded indebtedness, its liabilities are small, and Jack-

son I. Case, the owner of the road, expects that it will not be operated by the court very long. It appears that some of the mortgages upon the property were about to become due, and as the company could not meet them the receivership was determined upon. Mr. Case acquired the property in 1892, and within a year or so transformed it into an electric system. The capital stock of the company was $200,000.

The Common Council of the city of Oshkosh has granted to Frank H. Josslyn, who represents the Citizens' Traction company, a franchise to lay tracks on Mill and Ceape streets from its power house to the steam railroad tracks. The ostensible purpose of the franchise is to allow the company to haul machinery from the steam cars to its plant over its own tracks. Mr. Josslyn can transfer the franchise to the Citizens' Traction company, but this will not revive the franchise granted to the Central Wisconsin Electric Railway company, for the city attorney of Oshkosh holds that the action of the city in filing, with the street railway company's knowledge, a petition for the annulment of the old franchise will prevent the transfer to the Citizens' Traction company of any rights which were possessed by the Central Wisconsin company. The franchise granted to Mr. Josslyn runs for 32 years, so that it is contemporaneous with the Central Wisconsin company's old franchise. It is announced that work upon the tracks will be begun at once and that the Oshkosh part of the proposed inter-urban system will be completed within two months.

The Delavan Light & Fuel company, which is composed of capitalists of that city and which owns the electric lighting plant there, has asked for a 20 year franchise to construct and operate an electric railway connecting that city and the several parks around Delavan Lake. The plans call for about 15 miles of road. The summer travel between Delavan and Delavan Lake has grown to such an extent that it is thought that the line proposed will be a most profitable one. Work will be begun as soon as possible after the franchise is granted and the line will be in running order by early summer.

The Oconto Electric Lamp company has decided to leave Oconto, on account of the high rate of taxation in that city, and it is very likely that it will locate in Menasha. A representative of the company will soon visit Menasha for the purpose of looking over the ground.

The Supreme Court of Wisconsin has rendered a decision in a very interesting electric car accident case. The case was that of William L. Slensby, by his father as guardian, against the Milwaukee electric railway. About three years ago, when the boy was little more than two years of age, he was playing on Clinton street, in front of his home, when he was struck by a car and injured so badly that his left leg and left arm had to be amputated. Suit was brought against the company to recover $50,000 damages. On the first trial the jury returned a verdict for $8,000, but this was set aside, and on the second trial the boy was awarded $11,000. This verdict has just been sustained by the Supreme Court, and now the company must pay the amount of the verdict, together with interest and costs. It is the most interesting case of the kind ever tried in Milwaukee county.

In the Milwaukee Common Council a resolution has been introduced directing the city attorney to draw a bill requiring the street railway company to provide its cars with fenders. It is thought by some of the aldermen that several fatal accidents which have occurred of late would have been prevented had the cars been provided with suitable fenders.

The Milwaukee Common Council has adopted a resolution instructing the chief of police to ascertain whether the Milwaukee Electric Railway & Lighting company is complying with the ordinance regulating the running of cars on the different lines of the city. The company is really paying no attention to the ordinance, and all the city officials know it, the idea of the resolution being to get tangible evidence and prosecute the company for violating the ordinance. The resolution adopted by the council provides that the Police Department shall station officers on each line who shall observe the number of cars run, the number of cars not having vestibules, and the time between trips. The work is to be done between February 8th and February 15th, and blanks for the use of the policemen are to be prepared by the city clerk. President Baumgartner of the Common Council declares that the service is miserable, that cars are run in reduced numbers and not on time, and that there is great public indignation in regard to the matter. He declares that the company will be prosecuted if it be found that it is not living up to the requirements of the ordinance, and that if it turns out that the present ordinance does not provide for suitable service, then a new ordinance calling for more cars will be enacted. The serious phase of the situation, so far as the company is concerned, is that if the ordinance is a valid one, it may be compelled to pay any number of fines, one for every infraction of the law which can be proven.

The Milwaukee Electric Railway & Lighting company did not make any attempt to bring about the passage in the Common Council of Alderman Okershauser's resolution to direct the city attorney to discontinue all legal proceedings regarding the four-cent fare ordinance. At the last regular meeting of the council the resolution was voted down by a vote of 37 to one. The council has appropriated the sum of $1,000 to pay the expenses of Assistant City Attorney Van Wyck in taking testimony in other states, as the street railway company is doing. The assistant city attorney has some hope of winning the case.

The Milwaukee, Racine & Kenosha Electric Railway company, which is now operating its line between Milwaukee and Racine, is taking steps to secure a franchise south to Kenosha, and will extend its system to that point in the spring.

The Bower City Light & Power company's plant at Janesville has been sold at auction by the receiver. The property consisted mostly of wires and poles, and M. G. Jeffris bid it in on speculation at $1,175. C.

From the South.

MEMPHIS, Tenn., February 6.—W. S. Morse of Thayer, Mo., is figuring on an electric light plant for that place of 1,000 16 candle power incandescents and 20 2,000 candle power arc lights.

At the last regular meeting of the County Court of Shelby county, Tenn., a committee of five, with J. P. Young as chairman, was appointed to receive bids for an electric light plant for the court-house and jail of this city. Four hundred and fifty 16 candle power incandescent lights will be used.

Gen. Sam T. Carnes, president of the Memphis Light & Power company, was one of the first to start in the telephone business in the South. In 1878 he was engaged in the machinery business in this city, and his attention was called to the telephone by Post & Co. of Cincinnati, Ohio. Test lines were put up, and in 1879 he started business with 25 subscribers; his first printed list contained 35 names. By 1884 he had increased his list to 370. In that year he sold out to the Cumberland Telegraph & Telephone company, which has now over 1,500 subscribers.

That active salesman of the Partrick & Carter company of Philadelphia, Thomas L. Townsend, was in Memphis on Wednesday. He reports trade in the South to be good. After securing several small orders here, he left for the Northwest.

R. P. Martin, E. F. Young and E. H. Jennin of Jonesboro, Ark., have filed articles of incorporation at Little Rock for the Jonesboro Telephone company; capital stock, $7,500. The exchange was opened three years ago and now has over 100 subscribers.

George W. Borde, who has been doing business under the name of the Electrical Engineering & Supply company, has closed his business here and gone to New Orleans, his former home. R.

Northwestern Notations.

MINNEAPOLIS, February 6.—The Redfield, S.D., Power company will sink an eight inch artesian well for power to operate the electric light plant.

The city of Green Bay, Wis., has awarded the contract for an electric motor to swing the draw in the Main street bridge to G. P. Nichols & Bro. of Chicago, for $897.50.

C. B. Pride, a civil engineer of Appleton, Wis., is surveying for three water powers on the Menominee river, ranging from eight to 12 miles above Marinette, Wis. It is proposed to develop these powers and convey the power to Marinette and Menominee by electricity. The company is formed for the purpose and the preliminary work will be done this summer, but the actual work of improving the powers will probably not be done until 1898.

Opponents of the franchise granted David Douglass and H. M. Byllesby at Eau Claire, Wis., for a light and power plant, claim that it is illegal because the franchise was not published for two weeks prior to the passage by the council, as the law directs. Those favoring it say that is easily remedied, as the council will have the publication made and repass it. There is considerable interest in Eau Claire also as to what is to become of the street railway, which was omitted from the reorganization company. It is supposed that it will become the property of E. C. Hadley of Boston, when the receiver parts with it, and Mr. Hadley's plans are unknown. The line does not seem to be a paying one now, but it is claimed that it could be made so at small expense.

The Plymouth, Wis., electric light plant is having a new brick boiler house, to cost $6,000, built, and will put in two additional boilers of 150 horse power capacity each.

The court decided against the city of St. Paul in its contention that the National Subway company had forfeited its franchise, which required that two miles of subway be laid within a certain time. The company laid two parallel lines, one for high tension and the other for low tension, one mile in length. The court holds that this did not meet the conditions. Two months after the company made the claim that it had complied with the franchise, the council adopted a resolution requiring the company to receive into its conduits all the city wires, as provided in the ordinance, and this constituted a recognition of the subway company's claim of fulfillment of contract. The council cannot now interfere with the rights of the company after they have existed for seven years, and it has been in the power of the council to order the additional mile constructed at any time and as much more as it saw fit to call for.

The McDonald bill in the Minnesota Legislature to put street and electric railways under the jurisdiction of the state railroad and warehouse commission was reported adversely by the house committee unanimously. Mr. McDonald protested that he had no opportunity to explain his bill before the committee, and out of courtesy it was referred back, to give him the chance.

Ludolph A. Fullgraff of St. Paul has a device for enabling electric cars to overcome steep grades, the particular object to be mounted being the Selby avenue hill in St. Paul. The council has an ordinance pending ordering that line, which is now cable, changed to electric power. Fullgraff's device is a large cog-wheel set just inside the flange of the ordinary wheel of the electric car. The wheel is arranged so that five cogs are engaged at the same time. A cog-rail set inside of the regular rail and raised above it two inches, engages the cog-wheel and the power of the motor is applied direct to the cogs without raising the regular wheel from the tracks, as proposed in other devices. To insure striking the cogs true at the bottom the inventor will have the first three cogs lower, sharper and wider. Once engaged it is impossible for it to become disengaged. He claims that the cog-rail will not fill with dirt and snow, and the cog-wheel will act as a plunger.

The Fort Wayne Electric corporation won its suit against the village of Sleepy Eye, Minn., for the purchase price of its electric light plant, which the village refused to pay because the plant is alleged not to have come up to the specifications. The company will put in a new alternating machine of 650 lights capacity in place of the machine complained of.

The Redfield Power company of Redfield, S. D., has been incorporated, with $15,000 capital stock.

W. P. Fowler will probably be granted a franchise for electric lighting at Morris, Minn. He will utilize the power from his mill.

The Eau Claire Light & Power company has succeeded the Eau Claire Street Railway, Light & Power company in the lighting and power lines, and a Boston capitalist has purchased the street railway line.

E. E. McPeek of Winfield, Iowa, has sued the Western Union Telegraph company for $500 damages and interest for failure to deliver a telegram promptly. McPeek had learned of the probable whereabouts of a man charged with murder, for whose apprehension there was a reward of $500 offered, and was to be notified when he appeared in Morning Sun, Iowa. The message was filed promptly, but according to his statement it was not sent for two hours after its filing on October 22d, and was not delivered until 10 A. M. October 23d, although the company was notified at Morning Sun that it was important when it was filed, and the office at Winfield was also notified that McPeek expected an important message.

The American Loan & Trust company has filed a suit in foreclosure as trustee against the Electric Railway company of Burlington, Ia., to foreclose on a $300,000 mortgage on the plant, the former being named as

trustee by a majority of the boudholders. The Rochester Loan & Banking company of Rochester, N. H., has intervened demanding that its bonds of $10,000 be paid first before satisfying the other claims and alleging that fraud and collusion existed between the trustee, the committee on reorganization and the street railway company.

The storage batteries in the court house and city hall in Minneapolis will have new plates to replace the spoiled ones, and new and stronger ones added to make the batteries do the work required of them.

There has been $250,000 pledged in Tacoma, Wash., for the construction of a double track underground trolley line from the heart of the city to University place.

Mrs. M. I. Clark is an applicant for an electric light franchise at Mason City, Ia. It is understood that another company will make application soon.

The Decorah, Ia., electric light plant will begin operations in February.

There will be a small plant of 150 electric lights put in at Humboldt, Ia., soon, which is to be enlarged if the plant is successful

City Engineer Cappellen of Minneapolis suggests operating the waterworks pumps in Minneapolis by electric motors, securing the power from the new electric power dam, now being constructed. He holds it to be cheaper than steam power under any conditions. Mr. Cappellen also reiterates his views on the city owning a subway system for electric wires and compelling all companies now operating overhead wires to use it.

The Western Union Telegraph company has paid a tax of $19,000 to the state of Minnesota, based on the law passed at the last general election as an amendment to the constitution. It was accompanied by a formal notice that it was paid under protest, that the company waived none of its rights that might exist to recover in the event of the law being declared invalid, and that it did not recognize its validity. The law affects all telegraph and telephone companies, and a hard fight in the courts is looked for. C.

PERSONAL.

J. F. Hambay, manager of the Beacon Lamp company, New Brunswick, N. J., was in Chicago last week.

Leo A. Peil, secretary of the Racine Hardware company, Racine, Wis., was among last week's out-of-town Chicago electrical visitors.

Thos. E. Adams of the Adams-Bagnall Electric company, Cleveland, Ohio, and C. W. Phipps of the same city, one of the best known electrical engineers in the country, were recent Chicago visitors.

General Craighill, who has just been put on the retired list of the army, is talked of for the presidency of the Massachusetts Institute of Technology. Several other gentlemen are mentioned in connection with this desirable position.

Joseph Franklin, president of the Commercial Electrical Supply company, St. Louis, and one of the most popular men in the supply business, wrote his name on the register of the Great Northern Hotel in Chicago one day last week and proceeded to call on several of his Chicago friends.

H. H. Humphrey of St. Louis, a member of the engineering firm of Bryan & Humphrey, was in Chicago several days last week. From the marked increase in the demand for engineering advice, Mr. Humphrey anticipates that many important electrical projects will be carried out this year.

At the recent annual meeting of the American Association of Inventors held in Washington, the following-named officers were elected: President, F. H. Richards, Hartford, Conn.; secretary and treasurer, George C. Maynard, Washington, D. C.; members of the executive committee, C. C. Billings, Hartford, Conn.; Asa Bushnell, Springfield, O.; Robert S. Taylor, Fort Wayne, Ind.; Albert A. Pope, Boston, Mass.; Arthur Stuart, Baltimore, Md.; Mervin C. Stone, Washington, D. C.; James T. Dubois, Washington, D. C.; G. H. Shulte, Milwaukee, Wis.; Lewis Miller, Akron, O.

ELECTRIC LIGHTING.

The Charleston, S. C., Street Railway company will put in an equipment for supplying the city with electric lights.

The County Electric Light & Power company of St. Louis will increase its capital stock from $20,000 to $50,000 and erect a new plant.

Superintendent Patterson of the Jacksonville, Fla., municipal electric light plant will recommend the expenditure of $20,000 for increasing the capacity of the plant one-third.

The London *Chronicle* states that "for the Ocean Colliery company, one of the largest in South Wales, 10,000 electric lamps have just been received for use in the pits. The lamps cannot be opened by workmen, but only by special apparatus provided in the lamp room. The Ferndale and other large collieries in the district are about to adopt the same kind of lights, and the Davy will soon be among the lamps of the past."

The Benwood & McMechen Electric Light, Heat & Power company has been organized for the purpose of establishing electric light plants to furnish Benwood and McMechen, W. Va., with lights.

The extensive plant of the Scranton (Pa.) Illuminating, Heat & Power company was badly damaged by fire on January 31st. Half of the town was left in darkness, and the motors that operate the type-setting machines in the *Scranton Republican* composing room were left without power. Services in several churches were abandoned, owing to the lack of light and heat. The insurance is not over half the loss, which is placed at $50,000.

ELECTRIC RAILWAYS.

The South Chicago City Railway company now hangs on cars the sign "Delayed; Please Take the Next Car," in cases when the motorman is making up lost time and cannot stop at crossings.

The Syracuse, N. Y., Rapid Transit company has prepared plans for the year covering improvements to cost nearly $400,000. The light rails on many of the lines will be replaced by heavy ones, and the lines on Grace and West Genesee streets will be extended. A new power house is being built on Tracy street in the Third ward.

The newspaper paragraphers find good material for anecdote, truthful and imaginary, in the operation of the ubiquitous electric street car. This note is credited to the *Hartford Post*: "A fuse burned out in one of the Wethersfield cars the other evening, and the car at once came to a standstill. After a moment the motorman opened the front door, and putting in his head inquired, 'Can any lady lend me a hairpin?' His singular request was at once complied with, and in a short time the car was again under way. 'What did you want that hairpin for?' asked the woman who had supplied it of the conductor when that official came to collect her fare. 'To make a fuse out of,' was the reply, 'and I guess you are entitled to ride free this trip.' And she did, while the other passengers applauded heartily."

The officials of the Washington, D. C., electric railroad, one branch of which terminates almost at the doors of the Senate chamber, are very careful to maintain among their employes the *esprit de corps* necessary among those who come in frequent personal contact with United States senators. Where the "Senate car line," as it is called, ends, there has been placed a set of toilet articles, including a wash basin and stand, water bucket, towels and soap. As the crew of each car arrive at the Senate end of the route and prepare to make a return trip on which senators are apt to be passengers, they are expected to use the toilet articles and make themselves presentable. The public at large, especially strangers who are not accustomed to the ways of Washington, daily gaze with surprise on this out-door lavatory and wonder what it all means.

Happy relations between the press and city administration on one side and the street railway company on the other exist in the city of Binghamton, N. Y. In his annual message last month the mayor of that city said: "The Binghamton Railroad company deserves congratulation for the incessantly progressive spirit and character of its organization, and should receive all consistent encouragement in the proper extension of its lines in the city and the surrounding country. It is gratifying to note the tendency is toward improvement in all directions, and particularly in the matter of service afforded and the equipment of cars upon the various lines. We are credibly informed that the business of the company exhibits a handsome increase each succeeding month, demonstrating that the people practically appreciate a good thing by patronizing the efficient street car service that has been placed at their disposal in and about Binghamton."

TELEGRAPH.

The Morse Cycling club, composed exclusively of telegraphers and telegraph men, gave a dancing party at Medinah Temple, Chicago, on February 5th. A banquet to which Governor Tanner and Mayor Swift had been invited was enjoyed before the dance. The honorary members of the club was also invited to sit down at the dinner. They are Col. R. C. Clowry, L. D. Parker, E. J. Nally, F. H. Tubbs and W. J. Lloyd. S. F. B. Morse sent a picture of his grandfather, to be used for ball-room decoration. This picture is now the property of the club.

The Chicago Telegraphers' Bowling club and the Buffalo Telegraphers' Bowling club have agreed upon an inter-city match. It will be played by telegraph. There will be a special wire in each alley, and as fast as a play is made it will be clicked over the circuit to the rival athletes, and then in turn the rivals will roll, and what they accomplish will be flashed back over the wires. Chess matches by wire is an old feat, but chess is a slow, parlor sort of game, and the telegraphers must be given credit for an entirely new and novel idea in arranging to play such a lively and active game as bowling by wire.

TELEPHONE.

Charles Torbert contemplates the establishment of a telephone system at Oneonta, Ala.

A Strowger automatic exchange is to be established at Augusta, Ga., with P. H. Douglas as manager.

The City Council of Lexington, Ky., has appointed a committee to investigate and consider propositions made to the city for the construction of telephone lines.

I. H. Barnwell and A. F. Barbour are organizing the Mutual Telephone company for the establishing of a system at Yazoo City, Miss.

The Mutual Telephone company of Charleston, S. C., organized with a capital stock of $50,000, has matured its plans, and will begin at once the establishment of its proposed telephone system. Thomas & Hunter of Richmond, Va., have the contract.

A stock company has been organized by B. D. Evans, Jr., of Sandersville, Ga.; T. J. Arline of Wrightsville, Ga.; Louis Cohen of Sandersville, Ga., and others, for the purpose of establishing a telephone system in Dublin, Ga., for from 100 to 150 subscribers.

S. S. Creider, president of the Whiteside Harrison Telephone company, reports that since September 23, 1896, 71 new subscribers have been connected with the Lee County (Ill.) Telephone company, by erecting 79½ miles of cross-country lines and 12 miles of exchange lines. All the lines are of standard material and substantially built with No. 12 wire and 25 poles per mile, except seven miles, on which No. 12½ wire is used and 27 poles per mile. There are some telephones yet to be placed before spring, but the work on construction was stopped December 28th. During the same time Mr. Creider reports that his company has built 10 miles of lines and placed 10 instruments, with 42 orders on hand. The work of connecting the counties of Clinton, Lyons, Whiteside and Lee will be pushed forward as early in the spring as the ground and weather will permit, it being his intention by July 1st to give the patrons of the several companies communication with 900 telephones. Extensions yet to be made outside of Dixon and Harmon are, Stones to Rock Falls, Sublette to Maytown township, Pawpaw to Willow Creek, Stewart, Lee, Dixon, Nachusa, Franklin and Ashton, Dixon to Gap Grove, Prairieville and Sterling, and several other points not yet contracted for.

MISCELLANEOUS.

The annual catalogue of the Massachusetts Institute of Technology for '96–97 is a carefully compiled volume of 308 pages. It gives full information in relation to an important seat of technical learning, and may be obtained by addressing H. W. Tyler, 491 Boylston street, Boston.

A singular diversity of employment is proposed in the following *bona fide* advertisement in an English electrical journal: "Engineer (age 25), married, seeks engagement to take charge of electric light plant on country estate. Gas or oil engines, accumulators, pumps, etc.; seven years' experience. Wife could take duties of dairymaid if required."

A prominent western company of engine builders recently shipped seven carloads of machinery to South Africa. The machinery consisted of three cross-compound direct-connected engines of 1,000 horse power each, and each weighing 160 tons. The engines are for use in the production of electric power to drive pumps and hoists for one of the largest mining companies in South Africa.

The people of Sleepy Eye, Minn., are not yet prepared to believe that Grant Brambel, the young telegrapher of that town, has sold his rotary engine invention to an English syndicate for several millions of dollars. Speaking of the inventor, a correspondent of the *Chicago Tribune* says: "Some years ago Brambel was an operator at Skaneateles, N. Y., and created a sensation by announcing his invention of an electric lamp, which he had disposed of for $70,000. He said he was going to take a trip around the world, and left Skaneateles, but he only came to Sleepy Eye, and does not bear the evidence of having had the $70,000. Brambel may have patented this rotary engine, and may have sold it for several billion dollars, more or less, but it is the sentiment of the good people of Sleepy Eye that the outside world has been strung on the story."

During the coming summer an exhibition will be held in Prince Alfred Park, Sydney, New South Wales, under the auspices of the engineering and electrical associations of New South Wales. The exhibition will be opened in June, 1897, and continue open during the months of July and August. The object being solely for the advancement of engineering science and the promotion of a general and practical education therein, it will be non-competitive, but prizes and certificates of merit will be awarded to students and apprentices. Applications for space must be made not later than March 1, 1897, and exhibitors are requested to state whether exhibits will require special space, together with a description showing their nature and quantity. Motive power will be applied free of cost under certain conditions. All communications relating in any way to the exhibition should be addressed to the secretaries, Union Chambers, 70 Pitt street, Sydney, New South Wales.

F. G. Worth, managing director of the Acetylene Illuminating company of London, writes to *Engineering* as follows: "We have been engaged for 18 months in

conducting exhaustive experiments, before going to Foyers, in the manufacture of carbide, and it is only recently that we have felt justified in going beyond the experimental stage. Our new works at Foyers—where, by arrangement with the British Aluminum company, we have secured the temporary use of some of their spare power, pending the erection of a very much larger plant elsewhere (several thousand horse power)—are not yet complete. We are as yet quite unable to meet the demand, and, in fact, have to refuse several 50-ton orders, as we cannot guarantee delivery. At the present moment I believe that we could get orders for over 1,000 tons were we able to make carbide in sufficient quantity. As a matter of fact, there is a tendency to go too fast in the application of acetylene, it being apparently overlooked that, to make acetylene, carbide is a necessity, and that to make good carbide, on a commercial scale, specially constructed costly machinery and apparatus are required, with experience in their manipulation. Carbide cannot be made economically on a small scale. We do not expect that acetylene will supplant coal gas or the electric light in places where gas works or electric stations exist, unless the prices charged be abnormally high; but for country houses, churches, factories and villages where no gas or electrical works exist, as well as for lighting railway carriages and small railway stations, we are satisfied there is an enormous field for its use. We have commenced making carbide at Foyers, and we have turned out ingots weighing from over five hundredweight to over 10 hundredweight."

TRADE NEWS.

The engineering firm formerly known as Ford & Bacon is now Ford, Bacon & Davis, George H. Davis, M. E., having been admitted. The address is 220 Broadway, New York.

J. H. McGill, Chicago representative of the Peru Electric Manufacturing company, Peru, Ind., is not idle these days. He has secured a number of fine orders for the specialties he handles within the last few weeks.

The Electric Arc Light company of 687 Broadway, New York, secured for its "Pioneer" lamp the contract to light the new 14-story building at Broadway and Twelfth street in that city. The lamps are installed and the result is very satisfactory.

An order said to be the largest ever placed for manufactured tapering yellow pine poles, numbering 8,000, ranging in length from 25 to 55 feet, has just been awarded to S. C. Strock of 50 Broadway, New York, by the American Telephone & Telegraph company, for use on its lines. Mr. Strock was formerly connected with the Thomson-Houston and General Electric companies.

The C. H. Lever Manufacturing company, Chicago, manufacturer of electrical wood moulding and conduit, has been rushed with orders since the first of the year. The Lever company's woodwork is used by some of the largest and best houses in the electrical business, which, in itself, is the strongest recommendation it could wish for. Those interested in wood moulding for electrical purposes will find it to their interest to correspond with the Lever company.

W. R. Mason, one of the best known of the electrical men of Chicago, is hustling for business as actively as ever. The Mason Electric Equipment company, of which he is the moving spirit, has an office at 1202 Fisher building and deals in electric railway supplies exclusively. A lately issued circular states that the highest grade of material is used and mentions the fact that all the company's line hangers are fitted with patent locking devices.

That the Wirt dynamo brushes have long life is well known to the electrical trade. A recent letter from John Weyker, chief engineer in Kinsley's restaurant in Chicago, is a testimonial in point. The writer states that the Wirt dynamo brushes which were furnished four years previous have been in use seven days a week and about 15 hours per day ever since, and that the brushes are still good for some time to come, and that the wear on the commutator is imperceptible Mr. Wirt is located at 1028 Filbert street, Philadelphia, and reports that the calls for the Wirt brushes were never so large as at present.

W. McCullough, who has been looking after the Canadian General Electric company's interests for the past three years in the West, is now representing Hugo Reisinger of 38 Beaver street, New York, sole importer of the celebrated "Electra" high grade Nuernberg carbons. While the Canadian General Electric company regrets parting with one who has always been to the front where anything electrical was required, Mr. Reisinger is to be congratulated on his good fortune in securing the services of such an energetic salesman. Mr. McCullough's friends will wish him much success in his new position.

The almost universal use of electric lights in hotels and apartment houses interferes seriously with the use of many household conveniences, and, being alive to the needs of the times, the American Electric Heating corporation of Boston, in addition to providing small portable stoves, chafing dishes and curling-iron heaters (which may be attached to lamp sockets), now offers to the trade a small laundry iron of very convenient form and handsome finish. It is especially designed for the household sewing room and for ironing laces, handkerchiefs and other light work; for shining up the master's silk hat and pressing his trousers, on a pinch, though a heavier iron would be better. The current required is two amperes on a 110 volt circuit, and the iron is made for direct or alternating current and for all the usual voltages, as, in fact, are all of the company's appliances. A feature of all the new electric heating appliances is that they reach the desired temperature in from two to three minutes.

The Metropolitan Electric company of Chicago has been given the western agency for the Ham sand-box. This is a new sand-box for distributing sand and gravel on the rails while the cars are in motion. It is used on railroad trains as well as street cars. The great trouble with the sand-boxes now on the market is that they all operate with a valve, and this valve gets clogged up with the sand and gravel passing through it. This new sand-box does away with this difficulty by omitting the valve and substituting a simple device for equally distributing the material to be used on the tracks, whether it be sand, gravel or salt. The best evidence that the box is a good one is that the company is putting it out on trial, not to be paid for unless satisfactory.

The Partridge Carbon company of Sandusky, O., is doing more business than ever before. Its goods have a wide reputation, and the company is receiving some very large orders to be shipped to South Africa and Germany. Prospects are very bright for an increase in business this year. Some improvements on the dynamo brush are being made, and three grades—hard, medium and soft—are manufactured. The new generator brush is meeting with the best results; it runs smoothly with no sparking. The company solicits a trial from central stations which are having trouble in any way with their brushes. Its "self-lubricating motor brush" speaks for itself and has a reputation excelled by none.

The Central Electric company is carrying in its Chicago stock a complete line of snap, flush and push switches of the following makes: Hart, Perkins, Xntric, Stevens and C. S. It is prepared to furnish these goods made up in gangs with any particular finish to match special hardware. The company is publishing a four-page folder price-list of the Stevens push button switches, which it states will be gladly mailed to anyone in the business, upon receipt of a communication requesting it. The Central Electric company also states that the Scheeffer wattmeters are rapidly meeting with deserved popularity at the hands of central station managers. The company is pushing this superior instrument and has just compiled a special price-list, which will be mailed to central stations upon request.

L. W. Burch, formerly president of the People's Electric company, Madison, Wis., has sold out his interest in that company, and, with others, has organized the Electrical Supply company. This company will in all probability carry the many excellent specialties previously handled by the People's company, and will cater directly to the central stations throughout the Northwest. The headquarters of the Electrical Supply company will be in Madison, Wis., and Mr. Burch will be the president of the new company. This gentleman is very well known in the electrical trade, having been connected for many years with the Central Electric company, Chicago, and the Metropolitan Electric company. These connections have given him a wide experience in the business, and it seems altogether likely that his untiring efforts will make the new Electrical Supply company one of the leading houses in the Northwest. The People's Electric company will continue in the construction business.

The Stanley Electric company of Pittsfield, Mass., is certainly deserving of the congratulations which are offered to it on the healthy condition of its business during the year 1896. Its annual meeting was recently held, and all of its old officers were re-elected with the exception of W. W. Gamewell, its president, who declined re-election because of inability to attend to the duties of the office as he felt they should be administered, and G. W. Bailey was elected in his place. The annual report of the general manager, Henry Hine, shows that the business of the company has increased 16 per cent. during the last year, the total shipments amounting in all to $497,000, with orders for $125,000 more; and, notwithstanding this fact, the payroll was $12,550 less than during the preceding year. The Stanley Electric company is one of the best organizations in the business, and its continued prosperity has been the result of perfect harmony among its officers, and the great executive ability shown by General Manager Hine, whose indefatigable efforts have been given since the organization of this company to make it one of the most successful in the electrical business. To him must be given much of the credit for the company's success.

BUSINESS.

The theater dimmer price-list of the Iron Clad Rheostat company of Westfield, N. J., shows the great variety, in style and size, of the theater dimmers supplied by this company, which makes a specialty of this class of business, having supplied 2,500 dimmers, ranging from one to 1,440 lights capacity.

The Kennedy Valve Manufacturing company of 75 John street, New York, shows by its revised and extended catalogue the extent of its manufactures in valves and gates for steam and hydraulic machinery and also for gas, oil, ammonia and acids. A varied and extensive list is shown by this important company.

J. G. Pomeroy, Chicago representative of the Adams-Bagnall Electric company, Cleveland, Ohio, has among other orders secured one for thirteen 100-hour A-B arc lamps from the Miehle Printing Press company, Chicago. Mr. Pomeroy is one of the most energetic "hustlers" in the lamp business and deserves the success which has been his since his connection with the Adams-Bagnall company.

A. Louis Kuhmsted, general manager of the Chas. E. Gregory company, Chicago, has just returned from a trip to New York, where he went in search of bargains in second-hand electrical apparatus. Mr. Kuhmsted's trip was a most successful one. The company is in a position to supply almost anything in the way of electrical machinery, and, judging from the business with which it has been favored, it would appear that the bargains offered by the Gregory company merit the inspection of prospective buyers.

The Kartavert Manufacturing company of Wilmington, Del., reports that the call for its hard fiber continues to be fully as brisk as at any previous time. This company was among the first to appreciate that the electrical business required a particular grade of fiber and at once set about to produce the desired result. It manufactures hard and flexible fiber in sheets; also rods and tubing. Its patent insulating cleats were an immediate success when offered for sale, and the call for them is particularly brisk.

Catalogue No. 3 from E. B. Latham & Co. of 136 Liberty street, New York, shows a complete line of ventilating apparatus. Much space is devoted to electric ceiling fans, which are made to run on 50 or 100 volt circuits. Desk fan motors are to be had for both alternating and direct current, and are of such a large variety that it would seem that all wants could be fully supplied in this line. There is also an interesting description of new belted and direct-connected exhaust fans which have many new features.

Recent contracts for telephone material have been closed by the D. A. Kusel Telephone Manufacturing company of 1105 Pine street, St. Louis, as follows: 175 drop switchboard to replace switchboard formerly used by the West Point Telephone company, West Point, Ga., and furnishing 25 complete new telephones; 14 telephones, switchboard and all construction material for toll line in Lincoln county, Mo.; 14 telephones for 75 mile toll line at Corinth, Miss.; all construction material and instruments for an exchange of 100 instruments and 80 miles of toll line from St. Joseph to King City, Mo.

A large telephone order has been placed with the Farr Telephone & Construction Supply company of Chicago. The order comes from Kingston, Jamaica, and calls for a large number of telephones, as well as various telephone supplies. The fact that the Farr company was favored with the order goes to show that this company's instruments have found favor in foreign countries as well as in the United States. The Farr company is to be congratulated in being chosen among the many companies in the business, particularly as the order amounted to a considerable sum, and cash accompanied it. The order was placed through a New York broker.

The advance of the Morrin "Climax" water-tube safety boiler, made by the Clonbrock Steam Boiler company of Brooklyn, has been a notable feature of the industrial progress of recent years. Not long ago the WESTERN ELECTRICIAN described the factory in Brooklyn and the rise of the business from modest beginnings to its present proportions. Now a fine catalogue, handsomely illustrated, of 128 pages, has been issued to show the merits of the Climax boiler, of which Thomas A. Edison said: "Taking everything in consideration, it is, in my opinion, practically and theoretically, the best boiler so far invented." Thirty-two pages of "useful information" add to the value of the book.

The Electric Protection company of 1026 and 1028 Filbert street, Philadelphia, has been given the contract to place Stevens flush switches in the new Girard Building in that city, which, it is said, will be the largest office building in Philadelphia. The switches will be of special design, the plate being of bronze and elaborately engraved. There will be in all about 700 of the Stevens switches in use. This concern has also the order for the telephone junction boxes, the American District and Western Union call boxes, and there will be about 250 of each, also of special design in bronze and engraved. The equipment of the electrical plant of this building, it is said, will be superior to that of any other in Philadelphia.

The Central Electric company has taken the agency for the new Benjamin waterproof socket. This socket, designed by a man of many years' experience in construction work and particularly work pertaining to street railroad operation, is all that its name implies; it is so constructed as to be attached directly to seven-sixteenth or nine-sixteenth iron armored conduit and has sufficient metal in its shell to stand a great amount of very hard usage, and wherever used has easily proven its superiority. The Central Electric company has also the western agency for the Wagner alternating current ceiling fan motor. This motor is constructed on radically new lines and has many commendable features. Notably, it is absolutely noiseless in operation and consumes 120 watts when running at normal speed of 125 revolutions per minute; is guaranteed to produce an external agitation of the atmosphere without producing the same result on the purchaser.

The Apollo Iron & Steel company, Vandergrift, Pa., has ordered a direct-connected set for electric lighting. The engine, which is a 150 horse power vertical compound, built by the Ball Engine company, Erie, Pa., is

directly connected to a 90 kilowatt General Electric alternator. This company already has an electric light and power plant consisting of three 400 horse power tandem compound engines made by the Ball Engine company, which are direct-connected to Westinghouse generators of 225 kilowatts each. A very complete electric power and lighting plant is now being placed in position in the extensive works of the Schoenberger Steel company, Pittsburg. The power plant consists of one 400 horse power vertical cross-compound engine direct-connected to 225 kilowatt generators and one 175 horse power vertical compound engine direct-connected to 125 kilowatt generator. The engines were furnished by the Ball Engine company, Erie, Pa., and the generators by the Siemens & Halske Electric company, Chicago.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued February 2, 1897.

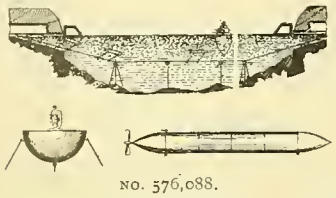
576,082. Automatic Switch. John P. Alexander, Jackson, Tenn. Application filed May 29, 1896.

A switch for electric circuits, comprising a divided and balanced circuit, switching devices connected in a bridge across the balanced circuit, mechanical means for disturbing the balance of the balanced circuit, and connections controlled by the switching devices for closing a supply circuit whenever the balance of the balanced circuit is disturbed.

576,088. Apparatus for Operating Submarine Torpedoes. William F. Brewster, New York, N. Y. Application filed March 11, 1896.

A submerged cable is constructed and adapted to constitute a track for guiding and controlling a torpedo in transit, and a torpedo is connected thereto.

576,095. Battery. Walter S. Doe, Brooklyn, N. Y. Application filed February 29, 1896.



NO. 576,088.

A carbon cylinder is adapted to receive an exciting fluid, a perforated non-conducting tube is suspended in the cylinder, while there is a cartridge in the tube comprising a cylindrical anode, having an outward opening and a depolarizer in the anode, and a contact with which the anode engages.

576,103. Electric Arc Lamp. Philip H. Fielding, New York, N. Y. Application filed April 23, 1896.

An opaque case is made of heat-resisting material, having a reflector formed on its inner surface and provided with a transparent window; openings in the case admit the carbons, the openings being substantially air-tight, and the case being hermetically sealed at all other points, whereby the life of the carbons is prolonged and the heat of the arc does not tend to injure the case.

576,129. Electrical Advertising Device. Leopold Julig, San Francisco, Cal. Application filed December 26, 1895.

With the stationary base and the table rotatable thereon there is combined the revoluble globe on an upright spindle which is also a conductor, the stationary magnets, the vibrating armature lever carrying on one end an armature arranged to move across the field of the magnets, the rotatable shaft, one end of which is geared into the globe spindle and the opposite end connected to the armature lever by a crank and pitman, the commutator on the shaft, the stationary arm and the commutator brushes secured thereto, one brush arranged in working relation with the cut-away portion of the commutator and the other brush set to make continual contact with the cylindrical portion of the shaft next the commutator; the conducting ring with which the lower end of the globe spindle is in electric contact, the contact-spring connecting the commutator brushes with such ring, and the contact-spring completing the connection electrically between the brushes and the central post of the structure, and the springs and connections completing the circuit through the parts between the wires from the two poles of an electric battery.

576,145. Method of and Apparatus for Electric Propulsion. Lewis H. Nash, South Norwalk, Conn. Application filed November 16, 1895.

The electric generator is run at a substantially constant speed; a translating device is constructed and arranged to translate into work a constant energy in watts at varying potential and current, the generator having on its field magnets shunt and series coils wound in opposite directions, whereby constant watts at varying potential and current are supplied to the work circuit as the resistance of that circuit varies.

576,164. Construction of Cells for Electric Accumulators. Friedrich W. Schneider, Triberg, Germany. Application filed May 2, 1896.

The combination with an outer vessel of electrodes therein, terminal connections for the electrodes, and an elastic rubber cover adapted to be stretched over the mouth of the vessel, having holes for passage of connections and having a thickened and strengthened edge and a tube for outlet of gases in the cover.

576,166. Automatic Block System. Judson Shoecraft, Harveyville, Kans. Application filed May 7, 1896.

An automatic block signal system, comprising a signal at each end of a block-section, a closed electric circuit comprising a ground wire containing a battery and the signal magnets, a second wire connected at each signal system with the ground wire, and a relay in each of the wires of which the armature forms part of the other wire.

576,177. Electrode for Storage or Other Batteries. Theadore A. Willard, Norwalk, Ohio. Application filed November 7, 1895.

A plate for batteries having its sides shaved into thin leaves and a central supporting portion increasing in thickness toward the top thereof.

576,178. Battery Plate. Theadore A. Willard, Cleveland, Ohio. Application filed May 4, 1896.

The plate has its sides provided with extremely thin parallel shaved leaves of equal thickness from the extreme edge to the base thereof, and with a uniform space between the leaves from their extreme edge to their base in which the material is enabled to form and expand.

576,208. Sounding Apparatus. Arthur M. Lozier, New York, N. Y. Application filed April 24, 1896.

The invention comprises a sinker containing a device which is moved by variations of hydrostatic pressure, a rheostat varied by the movement of the device, a circuit extending through the sounding line and including the rheostat, and electrical devices therein adapted to respond to variations of resistance in the circuit.

576,240. Electric Meter. John R. Tucker and Charles C. Hinckley, Aurora, Ill. Application filed January 25, 1896.

An interrupted curved movable contact surface is employed, a motor to drive it, a planimeter wheel rotating upon the interrupted surface so as to reach the line of interruption always substantially at right angles thereto, a register connected so as to be driven by the planimeter wheel, and a device actuated by the current to be measured, and adapted to vary the position of the wheel on the surface.

576,243. Contact Apparatus for Telegraphing. Cornelis Vreede, Rotterdam, Netherlands. Application filed January 6, 1896.

These essential features are mentioned: A source of electrical supply, a support, a ring rotatably mounted on the support, segmental strips of non-conducting material carried by the ring, conducting strips carried by the segmental strips, and being separated electrically from each other, and electrical contacts adapted to come in contact with the different conducting strips when the ring is rotated and close the electric circuit.

576,267. Advertising Device. Henry Green, Hartford, Conn. Application filed May 2, 1896.

An incandescent electric light globe is employed with a freely removable device, having one or more letters or characters thereon, and provided with means for directly engaging the bulb of the globe.

576,332. Locking Device for Electric Controllers. Gustaf Valley, Johnstown, Pa. Application filed November 10, 1896.

This is a rotatable switch, with a lever to operate it, a lug upon the lower side of the lever, a spring-pressed pawl adapted to engage the lug.

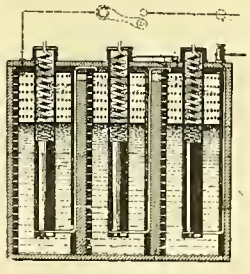
576,333. Electric Controller. Gustaf Valley, Johnstown, Pa. Application filed November 10, 1896.

Two operating drums are provided, and a reversing and cut-out switch, by the use of which either of the drums may be used to regulate the current to part of the motors, the other of the drums being inoperative.

576,342. Electrically Operated Musical Instrument. George H. Davis, New York, N. Y. Application filed March 25, 1896.

An armature is connected to a key; an electro-magnet actuates the armature; a source of electrical energy is provided, together with a resistance, and means operated by the armature when the latter is attracted by its magnet for cutting the resistance into the circuit to reduce the current passing through the magnet.

576,347. Electric Heater. Frederic A. Johnson, Binghamton, N. Y. Application filed February 24, 1896.



NO. 576,095.

There is a case having an opening to receive the article to be heated, a coil surrounding the opening, a laminated magnetic shell surrounding the coil and a connector, whereby the heater may be connected to an ordinary alternating current circuit, and the article to be heated applied in the opening and heated in the manner set forth.

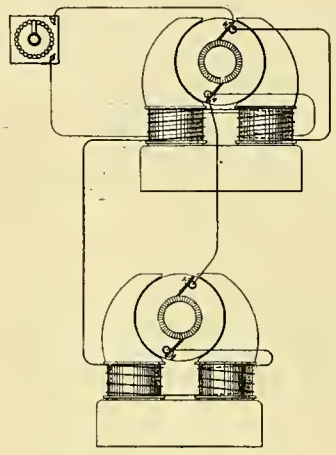
576,369. Automatic Electric Cut-out. Charles C. Kritzer, Newaygo, Mich. Application filed November 13, 1895.

Included in this device are an armature of an electromagnet, a swinging latch pivoted to the base, a swinging catch pivoted to the latch below the pivotal point of the latch and out of the vertical line of the point, and a suitable stop for arresting the movement of the latch until the same is detached by the movement of the armature.

576,372. Automatic Electric Cut-out for Magneto Bells. John Z. Miller, Baltimore, Md. Application filed September 23, 1896.

Each of the parted ends is provided with a spring contact-point; a metallic shunt piece is normally in contact with the spring points, and a third spring located opposite to one of the two springs and electrically connected with one terminal of a magneto generator; a lever is electrically connected with the other terminal of the generator and provided with a contact-point located opposite to the other of the two springs, and further provided with an insulated shield opposite to the third spring; a magneto generator drive-wheel and a crank therefor has a shaft loosely connected therewith; a cam wheel is mounted upon the crank shaft to be rotated therewith, but with free longitudinal movement thereon, the adjacent faces of the cam and drive-wheel being cam-shaped; a spring freely connecting the wheels and an arm of the lever bears against the end of the cam wheel.

576,392. Insulator. Harry E. Billings, Hartford, Conn. Application filed November 21, 1896.



NO. 576,145.

A screw-threaded cap having a circuit of ratchet crown teeth, a screw-threaded body portion having a spring-pressed stop-pawl adapted to engage one of the teeth to prevent loosening of the cap, and a deflector carried by the body portion and surrounding the insulator stud.

576,394. Trolley for Electric Cars. George L. Campbell, Shunk, Pa. Application filed March 18, 1896.

The combination includes a post, a trolley pole pivotally mounted thereon, a trolley wheel carried by the pole, an arm pivotally mounted on the pole, a spring in connection with the arm and pole, a flexible connection actuating the arm, the connection being attached to the pole, and an idler pulley carried by the post and over which the connection passes.

576,405. Spiral Trolley Wheel. Charles A. Langford, St. Louis, Mo. Application filed May 25, 1896.

Claim 1: A trolley wheel, comprising a wheel having an annular groove in its periphery, a stationary shaft supporting said wheel, a yoke supporting the ends of said shaft, wheels having spiral grooves mounted upon said shaft, one upon each end of said first-mentioned grooved wheel, said spiral grooves being designed to throw the trolley wire toward said first-mentioned grooved wheel by the frictional contact of said trolley wire with said grooves, said spirally grooved wheels being overbalanced so that the inner ends of their spirals will normally be at the top of said wheels.

576,472. Telephone Signal Transmitter. Ernest C. Robes, Medford, Mass. Application filed July 25, 1896.

This device comprises means for sending successive independent arbitrary signals, motor mechanism actuating the same, a telephone hook-switch controlling the motor mechanism, means for closing the circuit round the signal-sending mechanism, and means for closing it through the mechanism.

576,475. Electric Arc Lamp. Daniel A. Shesler, Toledo, Ohio. Application filed February 13, 1896.

One claim is for the combination with the upper carbon, of a lower carbon, an insulated support therefor, a conductor adjacent to the insulator, and a solenoid interposed in the circuit adjacent to the carbon, and having connections to the carbon and to the conductor adjacent to the insulated support therefor.

576,493. Electrical Circuit for Operating Automatic Railway Gates. John S. Biggar, Chicago, Ill. Application filed January 22, 1895.

Two electrical circuits are successively closed by the movements of a car to close and open the gate, and an intervening circuit also closed by the car holds the second circuit open until the entire train has passed a predetermined point.

REISSUE.

11,588. Electric Meter. Jesse Harris, Lynn, Mass. Application filed October 18, 1895. Original No. 543,865 dated August 6, 1895.

A pressure coil is arranged to have rotation and a resilient device connected with the pressure coil and with a motor, a current coil and a motor, and means to record the current passing through the current and pressure coils.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, FEBRUARY 20, 1897. No. 8

Chicago City Railway Company's New Electric Power Plant.

The new power house of the Chicago City Railway company at Forty-ninth street and Oakley avenue is of great size, as can be seen by the picture of it herewith presented. It will be used entirely for the generation of electricity, supplementing the old power house at Wabash avenue and Fifty-second street, which had become too small for the demands of the company's electric lines, on which 370 cars are now operated. In the amount of ground covered the new power house is probably the largest in the country, having a frontage of 276 feet on Forty-ninth street and a depth of 214 feet, while in capacity it is also one of the largest, as 7,500 horse power in engines and dynamos is now being installed, with space reserved to double this capacity when needed. The location is in a sparsely settled portion of the southwestern section of the city, but additions and new routes that are in contemplation will undoubtedly surround this station with a network of electric railway lines within a few years. The first actual work on the building was done on July 27th last, and it is expected that all the machinery of the first half will be installed by May 1st. At present only one pair of engines and generators is in operation, current being sent out from a temporary switchboard. The interior of the plant is still in the confusion and litter of erection work, although the station has been in use for nearly two months. However, an outline idea of the installation may be gained from the photographic reproduction of the exterior on this page and the plan and transverse section on pages 102 and 103, with the following brief description.

CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—EXTERIOR OF FORTY-NINTH STREET POWER HOUSE.

The building is of plain brick, well lighted and ventilated, with walls 45 feet high. It is divided by a wall of masonry into boiler room and engine room, but, as indicated by the plan on page 102, only the western half of the space will be utilized by the plant now going in. The present stack, at the northwestern corner of the building, is large, well proportioned and imposing. It is 207 feet high, reckoning from grade, built of brick, and the foundations, of railroad iron and concrete, extend underground to a depth of 35 feet, the lowest course being 49 feet square. The base of the stack is 28 feet square at grade and for nearly 50 feet the structure itself is square, receiving the breeching from the boilers at a considerable height from the ground, as shown in the photograph. Above this base the stack is circular, with a batter of 28 inches in a rise of 150 feet. The flue has a uniform diameter of 14 feet eight inches to the top of the stack. Between the base of the stack and the wall of boiler room there are two railroad tracks for coal cars or cars to remove ashes, used in conjunction with the coal and ash-handling machinery. The plant is particularly well located in the matter of steam railroad facilities, as the tracks of the Chicago & Calumet Terminal, Baltimore & Ohio, Northern Pacific, Panhandle, Michigan Central, Grand Trunk and Santa Fe companies run by the building, which is placed at a junction point. Spur tracks have been built on the Chicago City Railway company's block of property, so that, with the tank capacity in the building, 2,500 tons of coal could be stored on the premises if necessary.

In the boiler room, which is 270 feet long and 99 feet wide, 24 boilers have been set and one battery of six has been fired. The ultimate capacity is 48 boilers. Return tubular boilers built by John Mohr & Sons of Chicago are used, and they are arranged in rows, one row on each side of the room, with a wide space in the center. Indeed, it is noticeable in every part of the plant that ground room is plentiful, and space is not stinted. The boilers are fitted with Murphy furnaces and are 20 feet long and 78 inches in diameter, rated at 350 horse power each. There is an elaborate outfit of McCaslin coal conveyors and ash-handling machinery supplied by John A. Mead & Co. of New York. The duplex compound pumps are furnished by Weir & Craig of Chicago, and a Green fuel economizer of exceptional size is to be installed. The steam and water piping is all of the single system, and was put in by S. J. McCloud of Chicago. When the second half of the boiler equipment is placed in position a second smokestack—a counterpart of the one shown in the picture—will be erected at the northeastern corner of the building.

Six engines and six generators comprise the present equipment of the engine room—half of the total capacity of the station, as in the case of the boilers. The engine room is 270 feet long and 110 feet wide, with a double truss roof, having a line of piers of iron and brick as the central support. The engines are arranged in three pairs, each with a common shaft and fly-wheel, driving by rope transmission a pulley on a jack-shaft supplying power to the two corresponding generators. This arrangement of the three units is plainly shown in the plan on page 102. The engines are of the Green-Wheelock type, with Hill valve gear, made by the American Wheelock Engine company, and each pair is rated at 2,500 horse power. These twin-pair engines are run non-condensing at a steam pressure of from 105 to 110 pounds and at 75 revolutions per minute. The cylinders are 36 inches in diameter with 60-inch stroke, and a "Direct" separator is placed on the main steam pipe leading to each engine. The weight of each pair of engines is about 150 tons. The crank disks weigh eight tons each, and the shaft is 22 inches in diameter in the bearings and 26 inches in the hub of the fly-wheel. The bearings are 36 inches long. The fly-wheel is 20 feet in diameter and weighs 70 tons. It is grooved for 30 turns of 1¾ inch Manila rope. About a mile of rope is used on each unit, the Hoadley compound wind system of rope transmission being employed, with overhead sheaves and tension carriage.

The generators come from the Walker company's shops in Cleveland and are 10-pole, 800 kilowatt, 550 volt machines of the standard type of railway equipment made by that company. As has been stated, they are driven by a jack-shaft on which, between the generators, is mounted the driven pulley of the rope drive. This shaft has two Hill friction clutches, one on each side of the great pulley. Each of these clutches has 2,000 horse power capacity and is used to transmit the power from the pulley to the generator adjacent to it. This machinery is all large and massive, covering a great deal of space, and one of the 2,500 horse power units in operation furnishes an imposing spectacle. Each generator weighs 60 tons, and the driven pulley, with jack-shaft and clutches, weighs 26 tons, so that the whole combination of engines and generators in one unit weighs about 300 tons. In all, with the boiler-room apparatus, there will be about 1,350 tons of machinery on the foundations when the first half of the plant is finished, without taking the switchboard into account.

In keeping with the rest of the plant, the switchboard is very large. It is on a balcony 108 feet long on the southern wall of the building, 15 feet above the floor, from which it is reached by circular iron stairways at each end. The board is of slate, 97 feet long and 12½ feet high. It will have 12 generator panels and accommodation for 112 feeders, two circuits being controlled from each feeder panel. There is to be, in addition, a central panel for the main station ammeter, which is to read up to 20,000 amperes, and which, it is believed, will be the largest ammeter ever built. Each generator panel will be equipped with a wattmeter of 2,000 amperes' capacity at 500 volts. The bus-bars on this switchboard will have a sectional area calculated to be 24,000,000 circular mils. From the switchboard the cables will be led down and underneath Forty-ninth street in a tunnel; the arrangement shown in the picture on this page, by which the feeders pass out through the walls, is only temporary, although the steel poles for supporting the cables are permanent.

All of the engineering for this large plant was done in

the offices of the Chicago City Railway company. The men concerned in it are M. K. Bowen, general manager; R. J. Hill, chief engineer; C. J. Reilly, electrician of power houses, and George Kennerley, civil engineer.

Sixty-mile Railroad to be Operated by Alternating Current.

Specifications are about to be issued for the construction of an important and interesting electric railroad which will be 60 miles long and connect the cities of Detroit and Port Huron, Mich. The line will be of single track, with turnouts, and will run through the towns of St. Clair, Marine City, New Baltimore, McSweeny's, Pleasure Point and Grosse Point, following the western bank and shore of St. Clair River and Lake St. Clair and the Detroit River. The road will be used to carry passengers, mail and freight, and as it will possess unusual scenic attractions and pass through several popular summer resorts, it is anticipated that a large volume of pleasure travel will be secured during warm weather.

The road will be of standard gauge, and heavy steel rails will be used. Fifteen motor-cars and 15 trail-cars will constitute the rolling stock on the line. Two-car trains will be run, and the cars will be 46 feet long, the motor-cars weighing 33½ tons each and the trail-cars 20 tons. Probably each motor-car will be supplied with 200 or 300 horse power capacity in motors, so that a maximum speed of 60 miles an hour will be possible, although the running schedule will not call for a greater speed on any portion of the line than 45 miles an hour. It is the intention to make hourly trips over the whole line, with an additional local service.

In addition to the fact that the Detroit & Port Huron electric railroad will be perhaps the longest railroad in the country built for electrical operation, it is of much interest as an example of the application of the alternating current to railway operation on a large scale. There is to be but one generating plant for the 60 miles of road. This will probably be placed at McSweeny's, which, although but one-third of the distance from Detroit to Port Huron, will be at about the center of the load distribution. Here a power house will be built to contain, probably, four vertical, condensing, medium-speed engines directly connected to three-phase alternating current generators of about 800 kilowatts capacity each. Along the line it is proposed to erect four sub-stations for rotary transformers, from which direct current will be fed into the feeder circuits. The line construction will be of the standard overhead type. This interesting railroad will be built by John D. Dyar of Detroit, and Charles G. Armstrong of Chicago is the consulting electrical engineer.

Safety Devices for Electrical Circuits.[1]

By W. M. Stine.

Some subjects need an apology when introduced, and perhaps none more than the above caption. It is here presented in the belief that its consideration is still timely and useful, and the further reason that the writer has devoted much time, thought and experiment to it. Naturally, it at once suggests the fuse wire, but it is not the design to devote attention to this phase alone, but to certain mechanical safety devices as well and to give such results of their investigation as have not yet been published. The subject also suggests certain minor protective apparatus.

Thermal protective devices are as old as applied electrics, and it would casually appear that such an ancient matter, electrically speaking, had long since received due consideration, and one might see it rationally employed by manufacturers of porcelain goods, and every central station as well. But no general arraignment of practice is intended, the desire being rather to state how things should be, based upon the results of careful experiment.

THERMAL CUT-OUTS.

When an electromotive force is applied to a circuit and a current results, it is an indication that the circuit possesses continuous conductivity, or is a closed one. We may take any portion of such a circuit and call it a conducting element. Further, we may apply Ohm's law to each element. Knowing the ohmic resistance of any element, and the current intensity in it, the amount of heat it receives is expressed in watts by the numerical product of C^2R. Under conditions of operation, each and every circuit element is heated and becomes, to a certain extent, a thermal cut-out; it only remains to have the current sufficiently strong to carry its heating to the point of charring insulation or melting the conductor. By a fuse wire, we mean, then, a metallic element purposely inserted into the circuit, its size and melting point being so adjusted as to make it the weakest element in the circuit; and further, its weakness being so carefully adjusted that it shall yield before the other circuit elements are harmed.

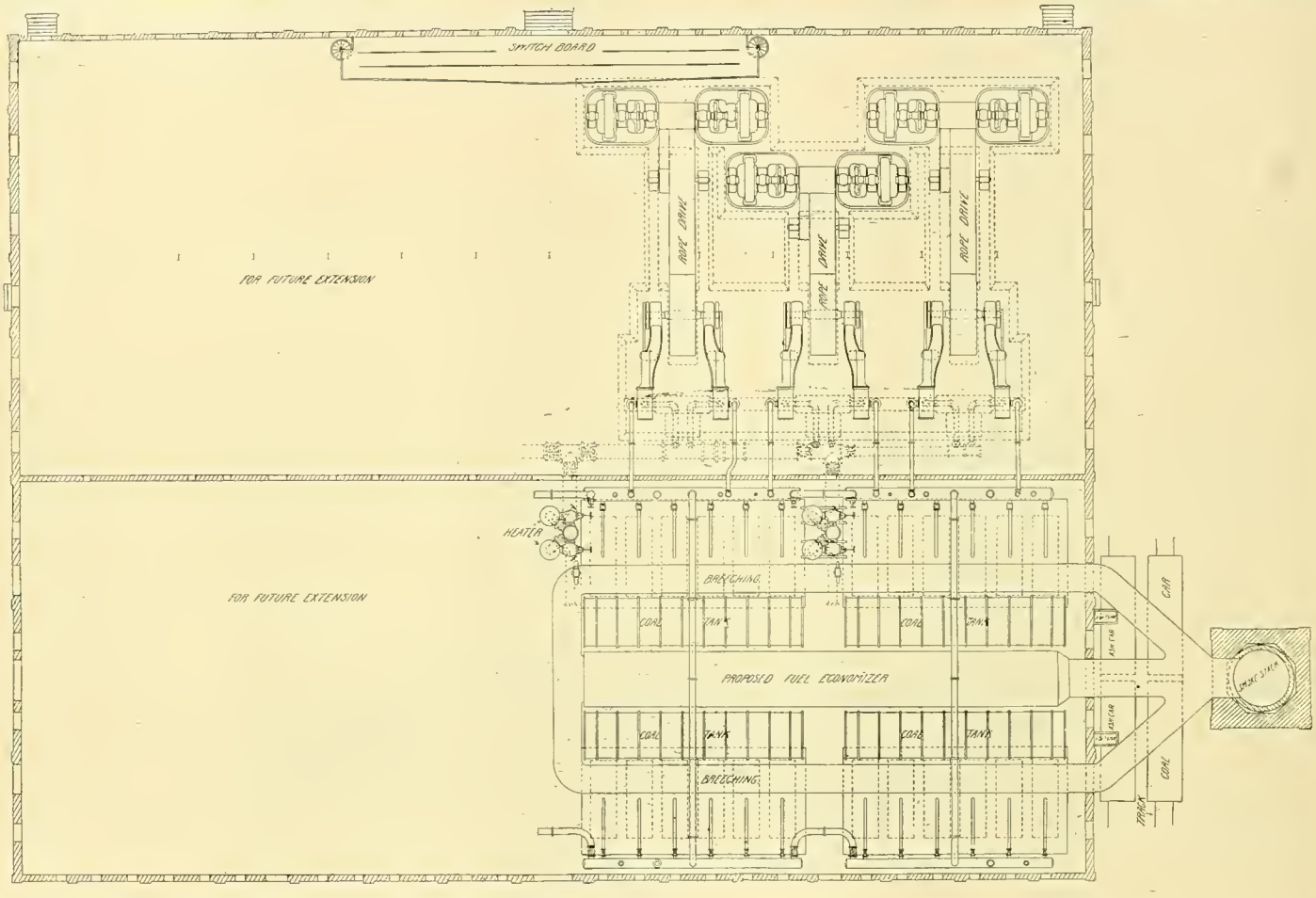
This is certainly the rational method of regarding a fuse in circuit, and of obtaining a just estimate of its protective value.

The protection must needs be as carefully studied as the device which affords it, bearing in mind that the protection demanded must vary with the nature of the circuit. The analysis of the protection is guided by the considerations just advanced—and the element of the circuit demanding it is that one which is structurally the weakest, and this in operation must always be considered as pitted against the fuse which is to protect it. Beginning with the generator, its armature has a known carrying capacity, and one which does not admit of a great margin. This is also true of the motor armature. In the leads, the need for thermal protection is slight; in branch and tap circuits it assumes a grave importance, increased by the uncertainty of joints and local corrosion. The transformer, again, offers much the same problem as the generator and motor.

In spite of extended use, the vagaries and uncertainties of the fuse wire became almost a by-word. The manufacturer of fuse blocks, beyond a change of material, wood to porcelain, had shown no satisfactory progress. The fuse wire had been investigated in a few laboratories, but in rather a casual and incomplete manner, and the results were confusing rather than instructive. It was this situation which, some two years since, led the writer to begin a series of exhaustive tests which should look toward formulating precise directions for the use and rating of fuse wires. The details of the processes and the data, amounting to several thousands of determinations, need only be here referred to. The principal points investigated were the time element and uniformity of fusing, the carrying capacity as influenced by length, diameter and enclosure, the effect of use and the influence of the receptacle. The value of the time element may not be at once apparent. To make the meaning clear, again consider an element of the circuit, such as an armature with relatively small carrying capacity or large C^2R loss, and insulation which at best is none too effective. So far as the relation of copper and insulation goes, the armature constitutes a fusible element, and against this is to be opposed a thermal protection. Let a sudden powerful rush of current occur. Both the armature and fuse wire suffer relatively large increase of heat, due to the C^2R losses in them. It is then only a question which shall let go the sooner. In general, the protective device should let go at once. An objection may be offered just here: in motor service a large onrush of current occurs when the motor is thrown into service. It is granted that this is just what does occur; but the question is here raised: Should it occur? So far as this is concerned, a motor should have as strong starting torque as possible, and wherever possible should be started up under a light load. Further, the starting resistance should be so proportional that the motor in starting shall take no more than normal running current. A more generally intelligent understanding of the limits of insulating materials will result in better care taken of the circuits. The careful manager will protect his circuits from all undue strain and sudden heavy current rushes as carefully as he would avoid pounding in the engine and for much the same reasons.

The uniformity of the fusing point of any given fuse wire is of the greatest importance. After considering the time element, the whole question of the proper use of fuse wire depends on its uniform action. Too often this question of uniformity in action has been taken on blind

1. Read before the Northwestern Electrical Association at Milwaukee, January 21, 1897.



CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—PLAN OF FORTY-NINTH STREET POWER HOUSE.

faith, based on the carrying capacity in amperes stamped on the spool.

We have found from our tests that this uniformity in fusing depends very largely upon the active lengths of wire used. It also depends upon the coating or oxide film, on the contacts to which it is fastened, and whether the fuse is open or enclosed, and whether the fuse is extended clear of the receptacle throughout its whole length.

The terminals to which the fuse is attached have an influence upon its blowing. The tendency is to use terminals which are too massive. In this way their cooling effect extends over several inches of the wire and allows only the balance, and usually there is none, to be truly effective. The cooling influence of the terminals can never be wholly avoided, but manufacturers of receptacles should endeavor to make it as small as possible.

From these generalizations we may turn at once to the results of tests.

To show the effect of the open and closed fuse blocks, a five-ampere round fuse wire was timed to blow in just one minute. In the covered block it carried 20 amperes for this time, with a distance between the contacts of one-half inch. In an open block, when the distance was seven-eighths inch, the critical current was 15 amperes. To illustrate the effect of the length of the fuse on its blowing time, and as well to show the supposed accuracy of the maker's rating, an eight-inch length fused in one minute with nine amperes. This has been selected as a fairly typical case from a mass of data.

To show the influence of the time element, a few tests may be cited. A three-ampere wire carried 35 amperes for nearly one second, and a 10-ampere wire 65 amperes for the same time, and this, too, with the wires under the most favorable conditions, having a fusing length of eight inches. One may well ask the effect with the lengths ordinarily employed; our tests showed the currents carried are several times as large.

One of the most instructive curves, which we platted from our tests was a set showing the influence of the length of the fuse upon its carrying capacity. These curves showed that after a certain length was exceeded, which depended upon the size of the wire, that they fused uniformly with the same current. As an example, a 16-ampere wire one inch in length fused at 28 amperes, two inches at 18 amperes, three inches at 17 amperes, four inches and over at 16 amperes. This definitely shows that this particular wire, if used on its rating of 16 amperes, should not be employed in lengths less than four inches; but if it is desirable to use it in shorter lengths the curve will indicate its capacity for such length. It would be an excellent plan for manufacturers to send out such calibration curves with their products.

In order to give the foregoing remarks a more tangible form, certain practical conclusions, which have already been published in the *Transactions* of the American Institute of Electrical Engineers for 1895, and elsewhere, may bear repeating:

1. Covered fuses are more sensitive and have a lower carrying capacity than exposed ones.
2. Fuse wire should be rated for its varying capacity for the lengths ordinarily employed.
3. Fuse blocks should be made with greater distances between the terminals.
4. Fuses should be removed from time to time, as they become coated or fouled.
5. The time element should be considered when protecting parts which are liable to burn out.
6. Fuses up to five amperes should be at least 1½ inches in length; one-half inch to be added to the length for each increment of five amperes.
7. Except for smaller sizes, flat fuses are more reliable than round wires.
8. Round fuse wire should not be employed in excess of 30 amperes' capacity. For higher currents flat ribbons exceeding four inches in length should be employed.

This subject cannot be dismissed without pointing out the duty of the manufacturer. The ordinary method of marking fuse wire is entirely inadequate. Each spool of wire should be accompanied by a curve or table clearly setting forth the carrying capacity for varying lengths. Better still, the use of wire should be discontinued, and fuses sold already mounted to copper terminals, plainly marked with their normal rating, which should be at least 80 or 90 per cent. of their fusing currents.

There is one form of mounted fuse almost universally used which is highly objectionable, even though used only on small tap circuits. The screw fuse plug is here referred to. Not only is the length of wire too short, but poor workmanship and liberal use of solder raises their fusing points to a dangerous degree. As a rule, their actual fusing points are double their marked ratings.

MECHANICAL CUT-OUTS.

This division will necessarily refer to a class of apparatus in which the current is led through an electro-magnetic coil connected by suitable mechanism to some form of switch, which under excessive currents shall open, either by magnetic or mechanical means. It is only fair to state at the outset that these apparatus involve points which admit of extended experiment and discussion—questions which relate mainly to the form of the actuating apparatus, but which, for our present purposes, need not be entered into.

A comparison with the thermal cut-out is at once suggested. The fuse wire is an indirect device. The electrical effect must be transformed into heat energy, and the distribution of heat in a metal is always slow. In a mechanical cut-out whose vital member is an electro-magnet, an excessive current acts immediately to open the circuit. There is here no transformation of energy and tardy distribution, as direct advantage is taken of the energy of the magnetic field which always accompanies an electrical current.

The discussion which follows is based on tests made upon electro-magnetic cut-outs, representative in design and manufacture of the leading styles on the market. As some of the old line electrical manufacturing companies have had circuit breakers on the market for some years, these were not deemed of sufficient interest to test, as their design is antiquated and not representative.

The tests were designed to show the time element of opening the circuit, the effect of creeping currents and the reliability of setting.

As our tests will soon be published in detail with curves and tables, the discussion here will not enter into detail. The time element in all the cut-outs tested was found to be very small. Whether the device opened with a spring directly released by the electro-magnet or indirectly by a blow, a minimum time element was soon reached, and this ranged from one-thirtieth to one-twentieth of a second. These small times may be termed the inertia time constants of the cut-outs.

For sake of comparison with the fuse wire, table I. is instructive.

TABLE I.—TIME ELEMENT.

Mechanical Cut-out.		Round Fuse Wire, 25 Amperes.	
Impulsive Currents.		Impulsive Currents.	
Amperes.	Time.	Amperes.	Time.
26.75	.099 second	25	300 seconds
27	.081 "	26	125 "
27.5	.081 "	27	103 "
28	.073 "	28	80 "
30	.066 "	30	50 "
30	.066 "	40	25 "
40	.059 "	50	13 "
40	.059 "	60	8 "
50	.055 "	70	5.4 "
50	.059 "	80	4.8 "
60	.055 "		
60	.051 "		
70	.048 "		
70	.051 "		
73	.051 "		
73.5	.051 "		

In order to understand the effects of creeping and impulsive currents, the physics of cut-outs must be referred to. We have fully shown in various papers that the fuse is characterized by great sluggishness of action, due to the slowness in general of heat changes. This is one of its gravest defects. An electro-magnet in which the iron core is relatively small is extremely prompt in comparison. Our tables show that the additional inertia time of the spring and mechanism is small. Compared with the fuse, the total inertia period of the mechanical cut-outs is very small.

In the fuse, the length of the inertia period is greatly influenced by radiation and conduction to contacts, so that creeping currents attain much higher values before the fuse blows than impulsive ones.

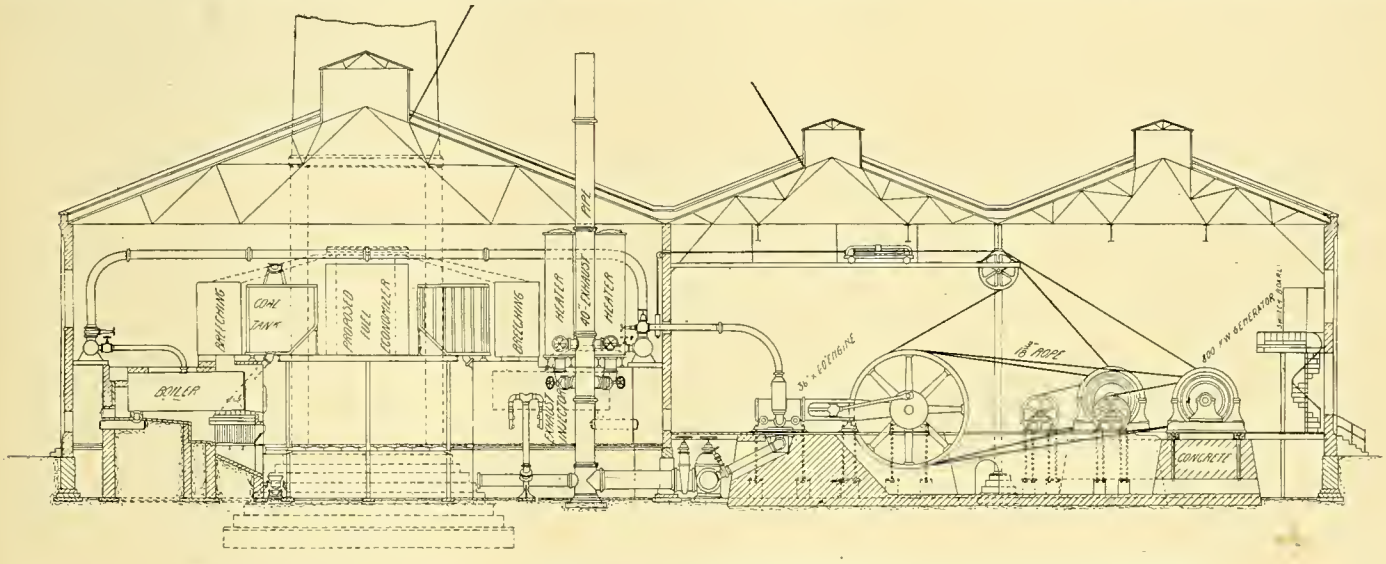
In the other class, the inertia period being almost wholly mechanical, the critical current of opening should be the same, whether the current is a creeping or an impulsive one. The following table exhibits these effects:

TABLE II.

Mechanical Cut-outs.—Normal Capacity, 40 Amperes.

Creeping Currents.		Impulsive Currents.	
Setting.	Opened Amperes.	Setting.	Opened Amperes.
20	18	20	17.2
30	25	30	22.7
40	30.5	40	30.3
50	39.6	50	37.5
60	44	60	43.5
75	53.2	70	52.5
80	64.2	80	62
90	70.4	90	70
100	84	100	77

There is but one principal factor influencing the reliability of the magnetic cut-out—the sticking of the mechanical parts. In those tested, this was found to be so small it was negligible. What would occur should the cut-out not be opened for months and the parts become corroded one cannot say. The reliability is clearly shown by table III.



CHICAGO CITY RAILWAY COMPANY'S NEW ELECTRIC POWER PLANT.—TRANSVERSE SECTION OF FORTY-NINTH STREET POWER HOUSE.

TABLE III.

Mechanical Cut-outs.—Normal Capacity, 40 Amperes.

I.	II.	III.
23.75 amperes	50 amperes	57 amperes.
24 "	50 "	56 "
26.75 "	48 "	56 "
23.75 "	50.5 "	56 "
23.75 "	50 "	56.5 "
		55 "

In the choice of mechanical cut-outs, simplicity is of great importance. The electro-magnet should contain but little iron, and the mechanism for opening the circuits should be powerful enough to insure prompt and regular action.

In view of the foregoing facts, the question arises, when to employ a fuse wire, and in what cases should the circuit breaker be used? This is a question to be decided by individual judgment, enlightened by a proper knowledge of the properties of both. It is advisable to keep fuse wires off switchboards entirely; they do not afford the requisite protection, and, besides, foul the board. For protecting motors, except in the smallest sizes, fuses are not reliable, and circuit breakers should invariably be used. The same plan is to be recommended for protecting transformers, though at present it seems rather impracticable. But in this same connection it is to be remembered that electro-magnetic cut-outs act as efficient choking coils and lightning protectors. For such places as distribution closets and tap circuits the fuse leaves little to be desired, and it would be well were it confined to such uses exclusively.

Another matter which demands fuller treatment than can be here given to it is the protection of large electro-magnets against high electromotive forces of self-induction. Transformers and the fields and armatures of dynamos and motors are here referred to. The subject has been treated at length in a recent article by the writer (*Electrical Engineer*, Nov. 25, 1896, p. 532). Only a few brief suggestions can here be offered. Due

provision should be made for absorbing circuits across the terminals of all electro-magnets. The simplest form which this protection can assume is a circuit of one or more incandescent lamps placed across their terminals. If the exciting currents in such magnets be suddenly interrupted, the incandescent lamps will absorb the energy which otherwise would spend itself in piercing and burning out the insulation. These lamps should be placed across the mains to such electro-magnets between them and all switches and cut-outs.

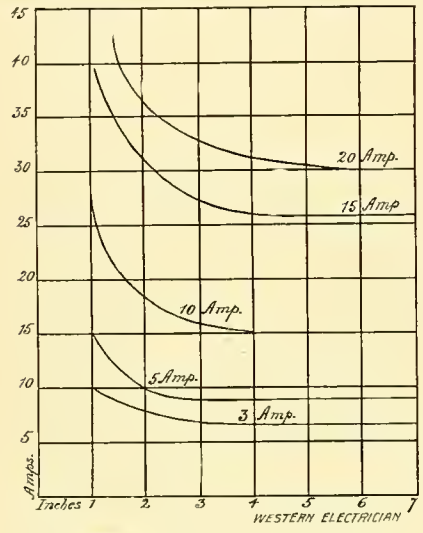
DISCUSSION.

In reply to questions by the members, Prof. Stine elaborated the following points touched upon in the paper:

"In our tests of length we made use of a block that we could adjust from half an inch up to eight or 10 inches, and by using the same wire in different lengths we could soon tell when no further decrease in carrying capacity resulted from an increase in length, and that we called the critical length. In all ordinary fuses (except flat ones) eight inches is a critical length.

"We put great stress on the time element, and I would say that our measurements were very accurate. It is unnecessary to go into detail, but we had a chronograph drum arranged so that when the current was thrown on the fuse, as soon as the switch closed the circuit, through the fuse, a spark passed on a piece of smoked paper, and sparks were passed from a tuning-fork in motion, and we could count the waves. Ten waves with the tuning-fork vibrating at 100 a second would be one-tenth of a second, and I will say that we had our adjustment made so perfectly that we could record $\frac{1}{1800}$ of a second. So if I go into the third decimal place of a second in my papers, it is not without authority."

The speaker called attention to the calibration curve



SAFETY DEVICES FOR ELECTRICAL CIRCUITS.—CURVES OF FUSING POINTS; CONSTANT TIME, 30 SECONDS.

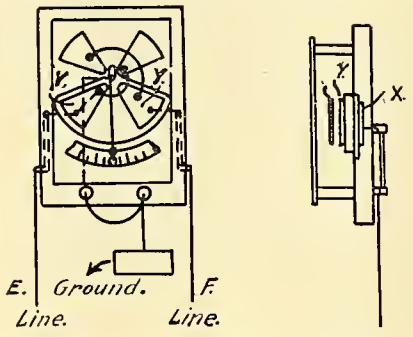
chart, and explained it as follows: "We have inches indicated on the bottom line up to seven inches, as fusing points. The amperes go from nothing to 45. These tests were made with a block in which we could adjust the distances between the terminals. A distance of seven inches on a three-ampere wire showed it fused in a constant time of 30 seconds with about 6½ amperes current; six inches length same time, five inches same time, four inches same time, three same time and same current. In fact the time is constant all the way through. When we took a length of two inches it took 7½ amperes to fuse, one inch 10 amperes, and this constitutes the calibration curve of the three ampere wire.

"Take the 15 ampere wire. In a length of three inches it fuses with a current of 24 amperes; it did that up to four inches in length. From four inches up it began to show a higher fusing current. At three inches the fusing current went up an ampere or so, and now for two inches it went up to 27 amperes and for one inch it was about 40 amperes. If you want to fuse a circuit you certainly do it for one thing, namely, to protect that circuit under a condition of normal or working current. Suppose that we wanted to fuse a circuit for 15 amperes; we do not want much more than 15 amperes on that circuit; that is the condition. Now we may have received from the manufacturer wire marked 15 amperes. How shall we use it? Simply because that wire is marked 15 it will not do to put it into any receptacle that you buy of the supply men, because those receptacles only have a length of one to two inches. Where will that fuse for a length of two inches? It will fuse at 37 amperes. So you are protecting your circuit for such an excess of 15 amperes, so that that fuse is worthless. It won't afford the requisite protection. Now suppose I have a circuit I want to fuse for 18 amperes; the distance between the block that I have connected in is two inches; what wire shall I use? I would use a 10 ampere wire as the curve indicates, this being the calibration for the material I am using. Of course these curves will vary with different varieties of wire; it will change if the percentage of tin is high or low and in proportion to the percentage of lead etc. That is an explanation of calibration curves.

"If you buy from a supply house a spool of fuse wire stamped 15 amperes, that really means nothing except that for four inches in length in that sized wire that will be the fusing point of that wire; but that is not a commercial length. What should be the duty of a supply man in this matter? He should accompany that wire with such a curve as that indicated in the diagram, or these results indicated in a table. Since publishing our first paper on this subject, a fuse company in Chicago has undertaken to do this. They send out their fuse wire now, accompanied by a table of this sort. If you order 15 ampere wire they will send it out with fusing points indicated for different lengths, based on a calibration curve, so that you can intelligently fuse your circuits."

Static Ground Detectors.

Attention has been especially directed at this time to the subject of static ground detectors by the paper of H. C. Wirt before the Northwestern Electrical associa-



Worked by inductive effect of Vane X on YY.

FIG. 2. STATIC GROUND DETECTORS.—TYPE B; CONNECTIONS FOR TWO AND FOUR-WIRE CIRCUITS, 10,000 VOLTS.

tion at Milwaukee, on "Protective Devices for Transformers," which together with the discussion was published in the WESTERN ELECTRICIAN of January 30th. In concluding his article Mr. Wirt called attention to several points where the transformer system, he said, could be greatly improved, the last of which was the following:

A ground detector which will positively indicate a leakage of current from primary wires to ground should be used at the central station. It should not be affected by the capacity effect of lines and it should be designed to be left permanently in circuit.

In the discussion that followed the reading of this paper, reference was made to the proposition to use a static ground detector, and this called forth a communication from John F. Kelly of the Stanley Electric Manufacturing company of Pittsfield, Mass., which was published in last week's issue, and in which attention was directed to a device of this character invented by Mr Kelly two years ago. A description of this instrument and the method of utilizing it will doubtless be interesting at this time.

This ground detector is essentially a differential static voltmeter made up of four vanes fixed to a base and a movable vane carrying an index or pointer. The movable vane is made of sheet aluminum mounted on a shaft and held centrally, by two jeweled bearings, between the fixed metal vanes. The diagonally opposite fixed vanes are connected in pairs, and each pair is statically charged from one pole of some source of electrical supply. The movable vane, which is connected to earth, is charged or not, and is the position of "no ground," the pointer indicating zero on the scale.

If one pair of fixed vanes and the movable vane are electrically connected, they are charged of like character from one pole of the source, the other fixed vanes being charged of opposite character from the other pole. The action of the similarly charged vanes is to repel the movable vane, while the action of the other fixed vanes is to attract it. By the two forces acting in the same direction, the movable vane takes the position entirely within the oppositely charged vanes, the pointer deflecting to the side of the similarly charged vanes and indicating the position of ground for that side.

The static ground detectors are made in three types, as illustrated herewith. Type A, Fig. 1, is designed for use on any two-wire or four-wire circuit of any electromotive forces over 500 volts and under 5,000 volts, and for three-wire three-phase circuits of the same voltages.

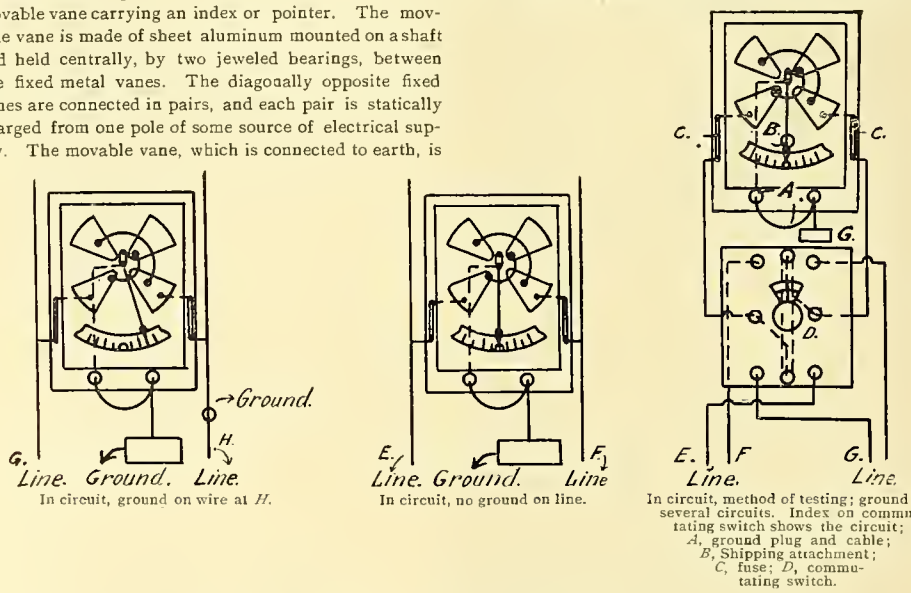
Type B, Fig. 2, is the same as type A, except for electromotive forces of 5,000 volts and higher. Type C, Fig. 3, is intended for use only on three-wire two-phase circuits and for electromotive forces over 500 volts and under 3,000 volts.

The general appearance of all instruments is the same. There is no connection through any of the instruments between the line wires or between either of the wires and earth. It is not necessary to first introduce a temporary ground on the line in order to test for an existing ground—the characteristic defect of the old forms of ground detectors. This feature insures greater safety to linemen and lessens the possibility of short-circuits in the instrument itself. It consumes no energy and may be left continuously in circuit, indicating grounds as soon as they occur.

In places where severe lightning storms are frequent and where the line is not adequately protected by lightning arresters, it is advisable to disconnect entirely the ground detector or open the permanent ground wire during such storms. The first may be done by the commutating switch *D* or by the ground plug and cables *A*.

Type A is mounted on a separate marble base or directly on the switchboard. It is entirely covered by a case of plate glass and all parts are perfectly insulated from the operator. In setting up the instrument it is necessary to see that the shipping attachment *B* is removed so that the pointer swings freely, and that the instrument is level so that the pointer will stand at zero when at rest. The line wires are connected by small terminal plugs through removable fuse blocks *C C* on either front or back of the instruments, to the fixed vanes. By inserting a commutating switch *D* between the line wires and the instrument, it may be transferred safely and quickly from one phase to another or to any one of any number of circuits.

Type B differs slightly in construction from type A, in that the line wires are connected to a primary set of vanes which are behind the visible fixed vanes and are



In circuit, ground on wire at *H*.

In circuit, no ground on line.

In circuit, method of testing; ground on several circuits. Index on commutating switch shows the circuit; *A*, ground plug and cable; *B*, Shipping attachment; *C*, fuse; *D*, commutating switch.

FIG. 1. STATIC GROUND DETECTORS.—TYPE A; CONNECTIONS FOR TWO AND FOUR-WIRE CIRCUITS.

inductively acted upon by each pair of fixed vanes, so that the stress produced by each is equal but opposite. The movable vane in consequence takes a position equally between the fixed vanes, which position is, theoretically, the same whether the instrument is separated from them by large plaques of hard rubber and mica. The visible fixed vanes are charged inductively from the primary vanes instead of directly from the lines. This type of instrument is mounted on a mahogany base, in which are imbedded the primary

vanes and the mica plaques. This construction secures perfect insulation for very high voltages, while in general appearaoce and in action the instrument is the same as type A.

Type C ground detector, io constructioo and io appearance, is practically the same as type A, differing only in having the vanes connected to the outside wires partially cut away.

This is the only ground detector that will work properly on a three-wire two-phase circuit; all others always indicate ground on the middle wire whether there is one

FIG. 4. STATIC GROUND DETECTORS.

or not, on account of the unequal electromotive forces between the wires. The relative potential of the middle wire of a two-phase circuit is dependent upon the capacity with respect to the earth, and this in turn upon the extent of the lines and their distance from the earth. For very short or very long lines, therefore, special adjustment may be necessary in order to make the instrument indicate correctly, but generally the standard type C instrument will meet all requirements.

Fuse wire used for all ground detectors is the well-known platinum silver wire used in Cardew voltmeters. All instruments are properly fused before leaving the factory, and an extra length of fuse wire is furnished with each. The manufacturer calls particular attention to the fact that the ordinary lead fuse should never be used. A general view of the instrument is presented in the cut, Fig. 4.

Lamp Filament Royalty.

In an article that seems to have beeo prepared after recourse to authentic sources of information, the New York *Sun* sets forth the facts in relation to the recently announced royalty on incandescent lamp filaments by the Westinghouse company. A portion is quoted:

No one will tell officially what the amount of the royalty is that the makers of lamps or filaments will have to pay. Those who represent the Westinghouse compaoy say it is a "reasonable" sum. Others say that the impost on filaments varies from one-third of a cent each on the ordinary 16 candle power lamp to as much as two cents on the filaments for the less-used fancy styles. The factory cost of the 16 candle power filaments is about $6 a thousand, so that the royalty of one-third of a cent each adds about 50 per cent. to their cost.

These constitute about 95 per cent. of the entire output of incandescent lamps. Lamp makers who were seen yesterday said that the royalties would add about two cents to the price of each lamp. It is estimated that there are 12,000,000 incandescent lamps used in the United States every year. An impost of two cents each upon all of these would amount to $240,000 a year, and the busioess is still growing.

The priocipal patent under which the royalties are claimed has about three years to run, but there are others which have a much looger life. The reason the owners of these patents have not demanded royalties under them before is to be fouod in the history of the long and bitter warfare which has been carried on between the Westioghouse and the General Electric companies for the control of the vast field of electrical development. About Edison and his inventions one moneyed host gathered, and aoother gathered about his rival, Westinghouse. Each coocern began absorbing others, and also securing control of all the patents regarding electrical devices which could possibly be used as a weapon against the other. Soon there was little left in the field which they did not control. Then they fell upoo each other io the courts and a Titanic struggle began. Because J. P. Morgan is a director in the General Electric compaoy and August Belmoot holds a similar place io the Westioghouse compaoy, it is popularly supposed that the struggle was between the two banking factions which they represeot.

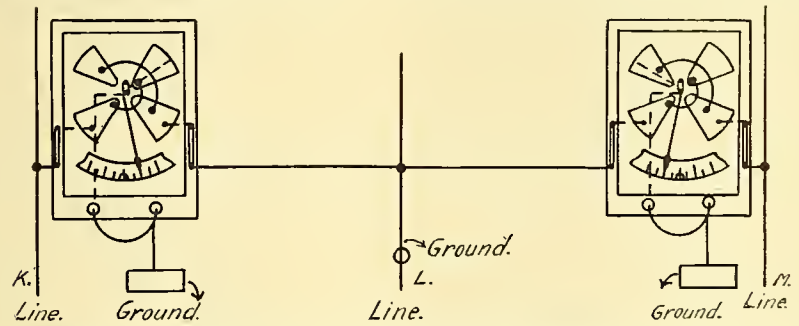
In the incandescent lamp part of the fight the General Electric company relied upon the Edison patent, and the Westinghouse people upon the Sawyer-Man patent. The Westinghouse company came out second best, and about eight months ago the two conceros agreed to stop fighting and pool their issues. Each agreed to license the other to use its patents. The lamp patents, however, were not included in this agreement.

After it was drawn up the Westinghouse company brought forth its latent patents. The most important of these is the result of an invention made by Edward Weston. About the time that Edison produced his first carbon filament Weston engaged in experiments in the same line. Edison tried cotton, silk, cardboard, bamboo, and many other things, but none was satisfactory. Weston discovered a way of making the filaments of vegetable parchment. That is what they are generally made of to-day. The Westinghouse company owns patents which cover the customary methods of treating these filaments, and also methods of lamp making, and a pump for exausting the air from the glass bulbs. Its new licensees have the use of all these patents.

The General Electric company makes about one-half of the incandescent lamps used in this country. It is asserted that the makers of 70 per cent. of the total output have taken out licenses, but some of the others have refused to do so, and the papers are now being prepared for the beginning of suits to force them to pay up or stop manufacturing.

Red Tape in France.

In discussing the dispute about the electric railway at Rouen, *L'Industrie Électrique* gives an amusing account of the difficulties in obtaining a concession to run street railways in France. "Suppose when walking in Trépigny-N'importe-quoi you have noticed a considerable activity in the streets combined with a complete absence of public vehicles. Having at home a few woolen stockings stuffed with gold pieces, it occurs to you to transform these into some sort of coaches which shall afford quick transport for the natives in return for a few halfpence. In this frame of mind you call on the mayor of the town, who, in his turn, summons his council, and, for a certain rental, authorizes you to run cars according to routes and time-tables which seem to him the most likely to give satisfaction to those under his administration. And this is all. There is still the police administration, but this is an unimportant obstacle. Yes, this is all; but only if you let your cars run on the street, and not on rails; if you lay rails in the street it is quite another matter. In this latter case time-tables, routes, profiles, plans, longitudinal and transverse elevations and sections, etc., have to be thoroughly examioed by experts, who will make reports. These reports will be studied by other people who are still greater experts, who live in Paris, and are perfectly cooversaot with the requirements of the inhabitants of Trépigny-N'importe-quoi. These experts, who, I believe, bear the name of 'conseilleurs d'etat,' will stipulate that the tramway shall pass this way iostead of that, aod that the time of departure shall be 6:45 iostead of 6:47. On the other hand, if the project does oot seem good to them the coocession will be refused If the documents provided are sufficient to enable the councillors to form a favorable opinioo, the matter will be sent to the Deputies, who will vote it 'of public utility.' Fioally, after the approbation of the Senate, 50 sigoatures or so, and some troublesome details of less importance, the buildiog of the line can be begun."



When wire *K* is grounded, pointer will deflect to the left; when wire *M* is grounded pointer will deflect to the right; with no ground on line pointers remain at zero; ground assumed on middle wire at *L*.

FIG. 3. STATIC GROUND DETECTORS.—TYPE C; CONNECTIONS FOR THREE-WIRE TWO-PHASE CIRCUITS.

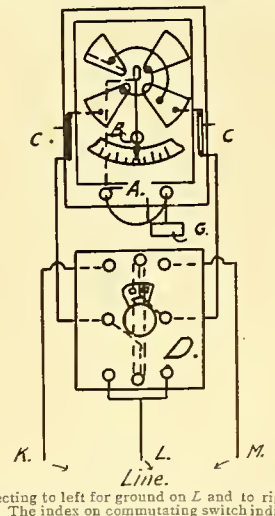
The Trolley Conduit Road in Chicago.

It is claimed that all arrangements have been made for financing aod beginning the work of coostruction of the Geoeral Electric Railway company, which is to build an underground trolley system of electric railways on the South Side, Chicago. Word has beeo received, it is said, that negotiations have beeo closed in New York whereby the first $3,000,000 worth of boods have beeo purchased jointly by Drexel, Morgan & Co. of Philadelphia, J. Pierpont Morgan & Co. of New York and the Love Electric Traction company of Boston. After the agreement between the compaoy aod the city had beeo eotered ioto, had received the signature of Mayor Swift and had been approved by the council, Attorney Hull, who represents the compaoy io this city, was authority for the statemeot that the work of construction would be commenced as soon as the frost was out of the ground. Large quantities of cement are used in the coostruction of the conduits, and the work cannot be done, it is claimed, in cold weather. It is said that the last of the contracts for the iron work has been closed and a large part of the iron material already completed for shipment.

The attorneys for the company have applied to the state attorney-general for a dismissal of the writ of error in the Supreme Court, and an appeal pending in the Appellate Court in a case taken up from the Circuit Court of Cook county, in which it was sought to eojoin the General Electric Railway company from the exercise of a franchise granted by the City Council of Chicago.

Consulting Electrician for State Institutions.

Governor Tanner is considering the advisability of appointing some competent electrical and mechaoical eugineer as the permanent adviser of the administration of the state of Illinois in remodeling the lighting and heating plants of the state institutions. Some of the plants are antiquated and poorly constructed. By substituting machinery and apparatus representing modern ideas of economy in fuel, in such cases, and rigidly inspecting and overhauling the construction work, it is thought that a great deal of money could be saved in operating expenses, and that, what is far more important, the danger of fire from electrical causes could be done away with in certain public institutions that are crowded with inmates. It is not intended to create a new office or a salaried place, but rather to specify some engineer to take charge of the work on a commission basis. Three gentlemen– C. G. Armstrong, B. J. Arnold and Frederick Sargent, all of Chicago—are mentioned as those from whom the governor will select the appointee. Mr. Armstrong holds a similar position for the state of Wisconsin.



Pointer deflecting to left for ground on *L* and to right for either *K* or *M*. The index on commutating switch indicates the phase. *A*, ground plug and cable; *B*, shipping attachment, *C*, fuse; *D*, commutating switch.

Western Electrician.

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HIGH WATER MARK

CIRCULATION, 16,630.

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MANY newspapers have printed in good faith a news item concerning the alleged invention by a Minnesota telegraph operator of a very compact and economical rotary steam engine, which an English syndicate was said to have purchased for a fabulous sum. Now, however, the Minneapolis *Times* claims to have investigated the alleged invention, and that journal asserts that not only has it not been sold, but that it is incapable of accomplishing the work claimed for it. Thus perishes the fame of Grant Brambel of Sleepy Eye, Minn.

AN immediate extension of the underground trolley system of New York is promised by the president of the Metropolitan company. Mr. Vreeland says that the same style of construction as that adopted on Lenox avenue will be followed on the new lines, and that the same equipment will be used. In view of the reports that have been made upon the operation of the Lenox avenue line this announcement was received with considerable surprise. It is known that the operation of the plant has been attended with great difficulty and that many delays and breakdowns have marked the history of the transformation. It was also said that the project was not commercially successful, and this fact led to the conclusion that no extensions would be made until improvements had been introduced that would remedy these drawbacks.

IT seems to be customary in New York for conductors on cable cars to cause the arrest of passengers who express dissatisfaction because of the lack of accommodations furnished by the company. This is a feature that has not yet been introduced in the street-car service in Chicago, and it is hardly possible that it will be adopted here, as it is quite likely that it would precipitate a riot.

IN stating, as many of our contemporaries do, that the first electrically operated sawmill in the United States is that put in operation last December at Folsom, Cal., the distinction should be made that it is the first permanent plant of that character—if such, indeed, is the fact. During the construction work for the World's Fair, in 1892 and 1893, there were probably twenty electrical sawmills in operation at Jackson Park, manipulating the enormous quantity of lumber that was worked up for the great buildings. These plants were installed for temporary operation, but they gave very satisfactory service and avoided what would otherwise have been a very serious danger from fire.

COMPLICATIONS and formalities are already beginning to make it difficult for an ordinary newspaper reader to follow the movements of the several individuals, corporations and governments interested in the proposed Pacific cable. The latest step announced was taken on February 4th, when President Dole received a letter from Alfred S. Hartwell withdrawing his application of October 23d asking for a cable contract from the Hawaiian government. At the same time Hartwell made a request for a contract in favor of the Pacific Cable company, for which he is the authorized agent. The company does not ask for an exclusive franchise, but it wants an annual subsidy of $40,000, and on this condition will undertake to establish in the island communication in addition to the Hawaiian-United States submarine cable within three years, should the contract be obtained and Congress act favorably on a bill now pending before it. The company which Mr. Hartwell represents is composed of prominent American capitalists and public men of international reputation. It is believed that the petition of this company will be favorably received by the Hawaiian government and granted at once, if assurance can be given of favorable action by the government at Washington.

WAR and rumors of war continue to occupy the public mind in spite of the promise of universal peace that is held out by the advocates of the proposed arbitration treaty, and it is quite probable that for many years to come nations and statesmen will be deeply engaged in the consideration of improved methods of attack and defense. The science of war at the present time takes advantage of the advancement that has been made in applied electricity, and the tendency seems to be in the direction of employing this factor wherever possible. It has been found particularly effective in torpedo work, the explosion of mines, etc., and for search lights, coast defense and signal service. During the Cuban war it has frequently been made serviceable by the insurgents. Dynamite bombs, electrically operated, were employed against the Spanish gunboat that was destroyed near Cardenas; it has been utilized since then in blowing up a Spanish military train on the railroad near Candelaria, in the west, and in the wrecking of a railroad bridge in the province of Santa Clara; it has also been employed in blowing up mines when Weyler's forces have been entrapped in ambush, and it has done effective work in all parts of the island during this season's campaign.

But it is in encounters upon a larger scale, especially in naval engagements and blockade work, that improvement has been most noticeable. These advancements, it is believed, will be effectively shown in the report of the big blockade at Charleston, S. C., by Rear Admiral Bunce's squadron which last week took up position off the entrances to Charleston Harbor and pretended to keep out those who would enter and shut in those who would come out. It is not practical of course to use submarine mines, etc., in mock engagements or to show in actual practice the operation of torpedos. For instance, the devices of Lieutenant Badt of Chicago and C. D. Haskins of Schenectaday, which were illustrated in the WESTERN ELECTRICIAN on December 5th, can not be shown to the best advantage in mimic warfare, but the essential features can be displayed.

In most of the modern war vessels nowadays the guns are handled by electricity and the movements of the ship itself are governed by the same means.

IN our issue of November 28th last we published an original article by C. C. Haskins of Chicago bearing the title, "How Many Volts Will Kill?" This article, with the omission of three paragraphs and a few verbal changes, was appropriated by the *Popular Science News* of New York and republished in the February issue of that periodical, with the original heading and the author's name, precisely as though written for the journal named, and with no credit to the source from which it was purloined. Misled by this publication, *Public Opinion* re-copied the article in its issue of February 4th, crediting it to "C. C. Haskins, in the *Popular Science News*, New York." Very frequently we see matter prepared for the WESTERN ELECTRICIAN copied without credit—indeed, there are two additional instances of this sort in the offending number of the *Popular Science News*—but we rarely make mention of this form of petty larceny, although endeavoring ourselves to be scrupulously honest in dealing with our contemporaries. But the case cited is so flagrant that we cannot let it pass without notice. The fact that the article was protected by copyright, as every issue of the WESTERN ELECTRICIAN is copyrighted, should also be borne in mind in considering this unpleasant subject.

EVERY improvement in the methods of conducting the Patent Office will be hailed with approval by the army of inventors, experts and solicitors who have business with that department of the government. The latest change that has been made will tend to simplify matters, it is anticipated, and it is believed that it will prove a positive advantage to all who are interested. New rules of practice have been promulgated by the commissioner of patents, and those familiar with former regulations of the Patent Office will recognize at once that many radical changes have been made. Not only are the new rules much less numerous but they are much shorter. The old rules of practice numbered 229, and these are replaced by 87 in the new order. A great deal of verbiage which was merely a re-statement of the patent statutes is omitted, and the new rules in general are more concise and clear than the old ones were. It would be impracticable to point out all the changes effected by the new rules. Perhaps the most important changes are those which occur in the rules relating to the conduct of interferences; for example, new rule 45 is as follows:

When an application involved in an interference shows and describes, without claiming, a patentable invention claimed by another party thereto, the applicant may, at any time within 20 days after the preliminary statements have been approved, on motion duly made, file an amendment of his application claiming such invention, and on the admission of such amendment such claim will be included in the interference.

This rule tends to make an interference proceeding inclusive of the whole subject matter of the controversy, and it makes it very important for interferants to scrutinize the applications of their opponents. Another provision of the new rules is the requirement of sworn proof of notice of taking depositions in interference and other proceedings.

In general, while the new rules are very clear, we believe it may be said that they do not attempt to give so much instruction to the public and contain less encouragement for the inventor to attempt to prosecute his own application. Rules 86 and 87 are as follows:

86. The office, to the extent of its jurisdiction, will consider equitable rights and apply equitable remedies, and whenever the foregoing rules and the established rules of equity are at variance respecting the same matter, the rules of equity will prevail, except in matters concerning the ownership or title of inventions, applications, patents or interests therein.

87. It is the design of the constitution and the patent laws to secure to the inventor not that which is a matter of common right, nor the property of another, but what he has himself created. The duty of the office is to grant nothing which already belongs to the domain of the public, but, on the other hand, not to withhold from the inventor any portion of the full benefit of his invention. Its function is to draw the line with even justice between the two.

These rules are in the interest of broad and liberal policy toward inventors, and, as a whole, the new rules are to be commended as having eliminated a large amount of useless material which had accumulated through years of practice.

Barrett's Discomfiture Complete.

It is seldom that such unanimity prevails in electrical circles as that which marks the expression of satisfaction over the revelations of the investigation into the abuses of the Electrical Department of the city of Chicago in connection with the recent letting of the contract for fire-alarm boxes. The result of the publicity given these proceedings is clearly manifested in the manner in which the subject is discussed. It is agreed that the report of the *Record's* commission placed John P. Barrett in such a position that he will find it impossible to clear himself in the eyes of the public. His discomfiture is manifested in his attack upon the gentlemen who fearlessly reported the actual condition of affairs which their examination disclosed. It is not anticipated that their professional reputation will suffer because of any criticism which a man of Barrett's attainments may make upon their work. Barrett will only make a laughing-stock of himself if he goes farther in this direction. On the other hand, his bitter attack indicates that the experts' disapproval of the action of the department has made an impression upon him as well as upon the public.

That Barrett and his associates at the city hall realize their danger is shown by the unusual efforts they are putting forth to counteract the effect of the disclosures that have already been made and prevent further inquiry. A systematic campaign of misrepresentation and personal abuse has been begun against those engaged in exposing the true condition of affairs in the department. Failing in this, an attempt was made to secure a reconsideration of the question of merit in the boxes, and Chief Swenie, at Barrett's instigation, proposed another test which he most kindly volunteered to conduct. The *Record* very properly declined to be a party to this proposed whitewashing arrangement, and in its reply to Swenie again called his attention to the facts that the commission which conducted the examination was approved by Barrett and him, that one member was named by Barrett and that all the conditions under which the test was made were submitted to the department and approved by Barrett. So far as the *Record* and the public are concerned, the question of relative merit was finally determined when the commission made its report. This leaves the matter in exactly the same condition it was last week, when the commission's report was published. The public, especially the electrical fraternity, is awaiting Barrett's next move in his futile effort to extricate himself.

An unexpected development and one of great importance is the fact that the publicity given Barrett's methods in this deal has aroused the insurance interests to action. Representative insurance men announce that they will no longer be satisfied with the Gamewell boxes which are used in the Chicago system, and they have appealed to Mayor Swift to secure the incorporation of the improvements suggested by the *Record* commissioners in all future boxes. This recognition of the commission by the insurance interests is a fatal blow to the pretensions of Barrett and Swenie.

Barrett's communication to Swenie upon the report of the commissioners contains an attack upon them and misrepresents the conditions under which the test was undertaken. These gentleman have already refuted Barrett's charges, and as he named one of the experts upon the commission and signified his approval of the selection of the other member, his later charge of incompetence merely goes to show how complete is his discomfiture. Chief Swenie came to his assistance by making the following proposition to the *Record*:

You published in this morning's *Record* a protest made to me by the superintendent of city telegraph against the finding of a committee appointed by you and approved by Mr. Barrett to test certain fire-alarm boxes whose relative merits have been disputed.

This whole matter has been settled by this department in the selection of that box which for many years has given uniform satisfaction, and while I may be going out of my province in discussing the matter further, I recognize that the officers of this department are public servants, and hence the public is entitled to complete information on the conduct of the public business.

I therefore beg leave to disapprove of the report of your committee on the grounds urged in the protest of the superintendent of city telegraph.

The mere inspection of the boxes was not a satisfactory test and proved nothing. If it is your desire to have a competent inquiry made into this matter, I beg to offer you my suggestions as to how it should be done. First let me say that I should not have consented to the inquiry if I had not been previously assured that actual tests were to be made. It was with that understanding, first and finally, that the boxes were sent to the Armour Institute. Unless tests were intended, I do not see why it was necessary to take the boxes down to the institute at all, when they could have been as well inspected uptown.

It is now my request that you select a committee of experts whose business it is to deal with apparatus involving principles identical with or similar to those involved in the fire-alarm box, in actual practice, instead of persons whose knowledge is confined to the theoretical work of the laboratory. I ask the privilege of fixing the details of such tests in order that I may be quite sure they will take the form of an actual inquiry into the merits of the boxes in actual service.

If I have your approval of such a test I shall be glad, if you wish it, to name to you three men whose official and professional positions and whose duties and attainments will be a guaranty not only of their freedom from bias, but of their entire competence for the requirements of such a test, and I will undertake to meet your entire approval in the selection of such a committee.

I shall be glad to hear from you to this end.

Of course the *Record* promptly refused to engage in this whitewashing enterprise. Its reply, by its editor, is appended:

I have received your courteous letter of this date, in which you suggest that "a competent inquiry" be made regarding the respective merits of certain fire-alarm boxes by a "committee of experts whose business it is to deal with apparatus involving principles identical with or similar to those involved in the fire-alarm box in actual practice, instead of persons whose knowledge is confined to the theoretical work of the laboratory." You make this suggestion because of your disapproval of the report of inspection of these same fire-alarm boxes made by a committee named by the *Record* and approved by you and the superintendent of city telegraph, such disapproval being on the grounds urged in the recent protest of the superintendent.

In that protest, approved by you, the superintendent of city telegraph says: "The report itself shows that no electrical test was made of these boxes, and the statement of the committee that no electrical test was necessary to demonstrate their efficiency is irrefutable proof of the incompetency of the committee and its unfitness to pass upon the matter in any way." You yourself say: "The mere inspection of the boxes was not a satisfactory test and proved nothing."

Permit me to express my thanks for the kind assistance you offer in fixing the details of tests of these fire-alarm boxes which shall satisfy you as to the practical nature of the inquiry. I regret that in the circumstances such tests, though made with your valuable co-operation, could not be conducted by the *Record* without an apparent acquiescence on its part in the judgment pronounced by you and the superintendent of city telegraph on the members of the former committee and the work performed by them at the request of the *Record*. I cannot think those gentlemen incompetent or unfitted in any way to render an expert opinion on the respective merits and demerits of the two fire-alarm boxes which were placed in their hands. You and the superintendent of city telegraph, as I am assured, regarded them as competent to make the investigation up to the time their report was rendered. As to the lack of electrical tests, the members of the committee say such tests were omitted with the knowledge and consent of the superintendent of city telegraph. Furthermore, they seem to have had a precedent for this omission in the report of inspection of the two boxes by Mr. Mehren, on which the recent award of contract for fire-alarm boxes was made by you on the recommendation of the superintendent of city telegraph. In that report, a copy of which is now before me, I can find no hint of the application of an electrical test. An inspection seems to have been regarded by Mr. Mehren, Mr. Barrett and yourself as sufficient in this case. Therefore, I do not understand why the members of the committee who acted for the *Record* should be condemned because they made a similar inspection of the same boxes.

Barrett's communication to Swenie is appended:

I am in receipt of a report from Messrs. Stine and Merrill, purporting to be a comparative test of the merits of certain fire-alarm boxes submitted to them. In reply I beg to state that the report itself shows that no electrical test was made of these boxes, and that the statement of the committee that no electrical test was necessary to demonstrate their efficiency is irrefutable proof of the incompetency of the committee and of their unfitness to pass upon the matter in any way.

It is impossible to know what an electrically operated fire-alarm box will do unless it is given an electrical test. This committee confined itself to a theoretical discussion of theoretical efficiency, and coupled with this discussion certain recommendations for the introduction into this class of apparatus of devices long ago discarded as utterly useless.

Replying to the point made by the committee that the Gamewell box did not meet the requirements of the specifications, I beg to say that the city box was the specific box from which the specifications were drawn. This box is one we have been using since the inauguration of this department. It has been brought to its present state of perfection by the Gamewell people, by the help of the experience of this department, covering a period of 30 years.

In conclusion, I beg to protest against the inefficient and prejudiced finding of this committee, and against any finding not based on actual test in service, and I further request that you demand a competent, unbiased and uncommitted committee to make a thorough test.

Mr. Merrill made the following reply:

I refused to take any hand in Mr. Barrett's fire-alarm box controversy until expressly requested to do so by him. I am sorry that he is displeased with the report of my associate and myself on the demerits of the devices in question, but after entering the investigation I could not in fairness overlook defects in his box while recognizing those in the box submitted in competition.

By referring to the report it will be seen that Prof. Stine and myself agreed with Mr. Barrett that certain features in the United States box rendered it unsuitable for use, and that in addition we found four additional defects which Mr. Barrett seemed to have entirely overlooked. Upon taking up Mr. Barrett's box it at once became apparent that the mechanism was, to put it mildly, not above criticism, and in justice to ourselves we were of course compelled to say so.

I regret that this has displeased Mr. Barrett, but I shall hope that in time he will see fit to take steps to remedy the defects noted, which are certainly consequential. It takes no great degree of technical ability or intelligence to appreciate the facts that rubber-covered wire is better than cotton-covered for box connections; that normally open contact points will gather dust or that it is undesirable to have commutative devices arranged so that the box can be left inoperative.

These and the other points made are worthy of Mr. Barrett's careful consideration rather than his invective, and I earnestly trust that in due course they will receive it.

To say that any piece of electrical apparatus is impossible of improvement is certainly a queer statement for an electrician to make, the more so if this mechanism has, as stated, not kept pace with recent electrical development, but has remained in practical retirement for a period of 30 years.

Professor Stine added:

I fail to see what Mr. Barrett means by his reference to the lack of electrical tests. I called on him with Mr. Merrill previous to the investigation and explained that we could not see that anything of this nature was necessary. At that time he agreed in this. It was agreed that we should simply "sit on" the boxes. The imposition of a trolley current on either of them would destroy parts of their mechanism, and there would be nothing proved by this not already shown. We had no authority to make a destructive test.

The only thing necessary in an investigation of this kind is to apply experience gained from other classes of apparatus containing contact points, and every electrician of wide experience knows full well the conditions under which contact points can be protected and relied upon.

Insurance people are interested in the controversy, as they claim that if the city has $7,500 to spend for new apparatus it would be better to get 166 boxes at $45 than 75 at $100, when both boxes are equal in every way and can be worked together on the same circuits. They insist that the increased protection under this arrangement would be far preferable to Barrett's plan to buy only Gamewell boxes. They have declared, too, that they will no longer accept the antiquated boxes which the department has been in the habit of purchasing.

Further reports from other cities confirm the statement that Gamewell boxes like those used in Chicago are sold for $50. In the East and South, where the United States boxes are in general use on the same circuits as the Gamewell boxes, the price is said to average $50. This feature of the controversy appeals to the taxpayers particularly, and it is hard to see how the mayor can escape giving it attention.

Ready for the Consolidation.

It is announced authoritatively that the preliminary steps in the negotiations for a consolidation of the Fort Wayne and Siemens & Halske companies have been taken, the work of taking the stock inventory of the two concerns has been completed, and the appraisers have completed their task. The principals are now considering the terms of agreement, and according to the best information obtainable in Chicago the matter now rests entirely in the hands of R. T. McDonald.

The aldermanic committee on streets in Buffalo has reported favorably the request of the Cataract Power & Conduit company for an extension of time in which to make good its promises. The time is extended from June 1, 1897, to December 31, 1897.

Watson Telephone Switch Patent Held to be Invalid for Want of Novelty.

In the case of the Western Electric company against the Western Telephone Construction company, Judge Showalter of the United States Circuit Court at Chicago has decided that the Watson telephone switch patent No. 270,522 is invalid as possessing "no novelty or invention in any one of the eight claims." The opinion was handed down on February 10th. As the readers of the WESTERN ELECTRICIAN are undoubtedly aware, this is the fundamental patent covering all forms of the hook switch common to Bell telephones

While the infringement suit against the Western Telephone Construction company was pending it was discovered that the patent had expired by limitation on July 30, 1895, the date of the expiration of the Canadian patent on the same invention, or alleged invention. However, this defense did not come into the case against the Western Telephone Construction company, although employed effectively in at least one other suit brought for infringement of patent No. 270,522. There were two reasons for this. One was that the defendant company, if acknowledging the validity of the patent up to July 30, 1895, would have had to pay damages for infringement up to that time, and these damages would have amounted to a large sum of money. The other reason was that Mr. Stout, the attorney for the defendant, had adopted a line of reasoning as to the invalidity of the patent which he wished the court to pass upon. He held that the fact that the telephone was once new does not confer novelty on every aggregation of old devices simply because a telephone forms one feature of such a combination. The decision of the court proved the soundness of Mr. Stout's judgment. This is said to be the first case in which a Bell telephone patent has been set aside as invalid, and the theory of the defense may prove valuable in similar causes.

The case was pushed vigorously for the complainant, whose attorneys were Barton & Brown of Chicago, while at the argument last April F. P. Fish, the Bell company's famous patent lawyer, came on from New York to argue the case. Stanley S. Stout of Chicago conducted the defense unaided. Among the experts examined were T. D. Lockwood of Boston for the plaintiff and Forée Bain of Chicago for the defendant. Some of the testimony was taken in California.

The text of Judge Showalter's opinion is given in full, while the accompanying reproductions of the two sheets of drawings in the patent may assist in giving an understanding of the nature of the device in suit:

The complainant sues for the infringement of letters patent of the United States No. 270,522, issued January 9, 1883, to the American Bell Telephone company, assignee of the applicant, one Thomas A. Watson.

As stated in the specification, the subject matter of the invention is: "An Improvement in Telephone Switches." I quote further from the specification:

"The invention consists in the use of a single lever in connection with a telephone and a call circuit and proper contact points in such manner that a movement of the lever in one direction disconnects the call circuit from the main line, brings in the hand telephone and secondary circuit of the transmitter and at the same time completes the primary local circuit of the transmitter, while a movement of the lever in the other direction cuts out the hand telephone and secondary circuit of the transmitter and restores the call circuit. The invention consists further in making the lever operative as a switch, as aforesaid, in the form of a hook supporting the hand telephone and combining therewith a spring in such manner that taking the hand telephone from the hook causes the lever automatically to disconnect the call circuit, bring in the hand telephone and secondary circuit of the transmitter and complete the local primary circuit; while hanging the hand telephone upon the hook causes the lever to automatically cut out the hand telephone and secondary circuit of the transmitter and restore the call circuit."

The patent contains eight claims, and it is insisted that each claim is valid and has been infringed. The fourth claim is as follows:

"In combination with a magneto-generator, a main line telephone circuit and a shunt circuit passing through the magneto-generator, the push-button U to break the shunt circuit, substantially as described."

As shown by the specification and diagrams, when a signal call is sent to the office of a subscriber, the current passing over the main line coming to the stud t in the instrument passes around the magneto-generator through the contact point T. When a subscriber desires to signal he breaks the contact at T by means of a push-button and the current is then sent through the call circuit by means of the magneto-generator, its coils being then in line. If the generator were operated without breaking the contact at T, I suppose there would be a short-circuit around the magneto-generator from the point T, through the coils of the magneto-generator to t, thence by wire w^{15} to T. By pressing the push-button U the current generated by the magneto-generator is necessarily sent through the line. The function of the press-button U is thus to bring the coils of the magneto-generator into line when the subscriber desires to signal a distant station and to leave these coils out of line and so get rid of the resistance which would otherwise be offered by them when a signal is sent to his office. The expedient here shown, as I understand from the evidence, is common and well known to electricians. In the patent, for instance, to T. A. Edison, No. 203,017, the secondary coil is short-circuited when the instrument at the subscriber's office is in condition to receive a signal. If this long coil were left in circuit the resistance would be too great. It is therefore shut out of the circuit when the instrument is not in use and is in condition for receiving a signal. The movement of the handle S away from the point 2, where it ordinarily rests, breaks the short-circuit in the Edison patent and brings the secondary coil into line. In that patent the secondary coil acted on inductively by the primary coil is used in the place of a magneto-generator. By throwing the handle S to the contact point 3 a subscriber gives the signal when he wants to communicate with a distant station. The breaking of the short-circuit, when the magneto-generator is to be used in the patent in suit, is accomplished substantially in the same way in the Edison patent and the same purpose is in view in both cases, namely, to keep the long wires of the magneto-generator in the one case and of the secondary coil in the other out of the circuit in order to get rid of the increased resistance.

In view of the evidence here and of the patents introduced, I see no novelty in the combination of the fourth claim; nor, for substantially the same reasons, is there any novelty in the fifth claim. I may add, also, as respects the fifth claim, that it is rather an aggregation than a patentable combination. The push-button in connection with the call circuit serves to bring into line and shut out of line the magneto-generator, but the switch lever and its contacts serve to combine the three circuits—the call circuit, the local circuit and the telephone circuit—that is, to break the call circuit and put it out of use when the other two circuits are in use. These three circuits are made and broken by means of the switch lever, but the push-button has nothing to do with the operation of that lever. No modified result follows from any combination of the push-button in the call circuit with the switch lever. When the subscriber wishes to give a signal at a distant station he does not touch the switch lever or hook, nor when a signal is sent to him from a distant station is the switch lever or hook in that operation manipulated in any way at either station. The switch lever, so far as the signal or call circuit is concerned, is simply part of the circuit. That circuit could be used merely for signaling purposes independently of the rest of the machine. For that purpose the switch lever or hook has no function whatever, as already said, except as a mere part of the circuit. The function of the shunt circuit, push-button and magneto-generator is limited to the call circuit, and the hook or switch lever serves no function as a hook or switch lever in connection with the push-button, the magneto-generator and the shunt circuit. The claim, therefore, joining the switch lever with its contact points, whereby, according to the position of the switch lever, it completes either the call circuit or the telephone circuit with the magneto-generator, the shunt circuit and the push-button in the call circuit, is an aggregation rather than a patentable combination. But, at all events, my opinion is that there is no novelty in either the fourth or fifth claims, in view of the evidence shown in the record.

The first claim is in words following:

"In combination with suitable contact points and springs electrically connected with the call circuit and the primary and secondary circuits of the transmitter, the latter circuit including the hand telephone, a lever electrically connected with the main line in a telephone circuit, substantially as described, to bring in the hand telephone and transmitter and break the call circuit, or to cut out the hand telephone or transmitter and establish the call circuit, according as the lever is moved in one direction or the other."

The second and third claims show in addition to what is set forth in the first, the hook and the spring by which it is thrown up when relieved of the weight of the hand telephone. The sixth, seventh and eighth claims are apparently covered by the first, second and third.

On the showing of the drawings and specifications, when a subscriber is not using his telephone it hangs on a movable hook, which is the end of the lever. The hook then rests in such a position that the call circuit is complete. By removing the weight of the telephone from the hook a spring throws the hook up and by means of two contact points two electrical circuits are established—one the local and the other the circuit to line. The function of the local circuit is to create the electrical current in the telephone circuit by induction. This special use of a local current in connection with a transmitter for inducing the current in the main line is not of itself claimed in this patent. The patentee, Watson, was not the inventor of the same. What he does in the patent in suit is to utilize these two currents in connection with the call circuit. Prior to the times when a separate transmitter was made use of the telephone was used both as a receiver and as a transmitter, and instead of the three circuits there was only the call cir

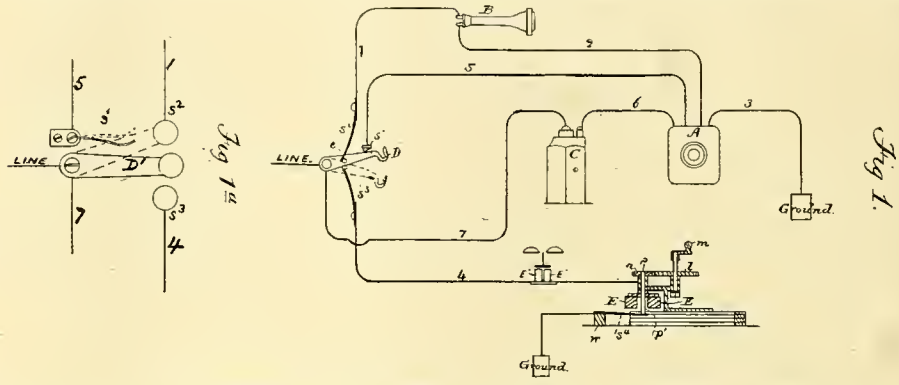
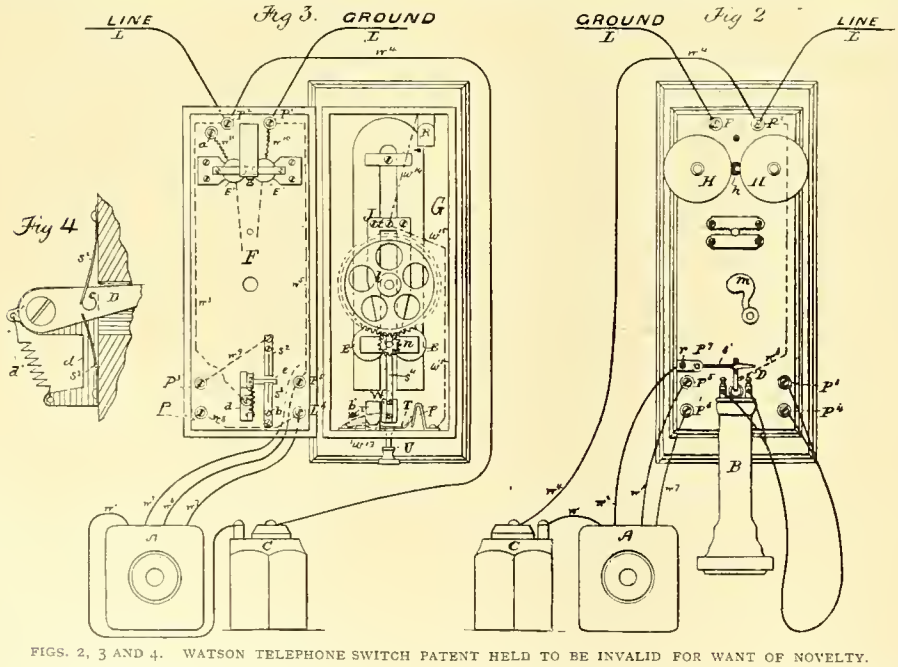


Fig. 1.

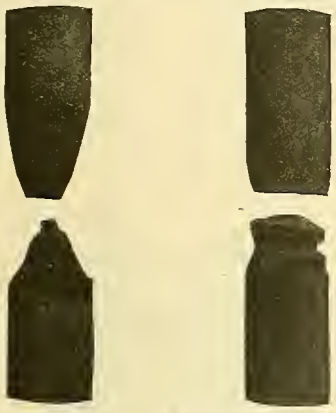
Fig. 1a.

FIG. 1. WATSON TELEPHONE SWITCH PATENT HELD TO BE INVALID FOR WANT OF NOVELTY.

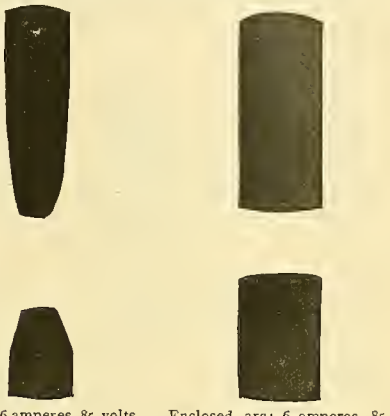


FIGS. 2, 3 AND 4. WATSON TELEPHONE SWITCH PATENT HELD TO BE INVALID FOR WANT OF NOVELTY.

cuit and the telephone circuit. While the art was in this condition patent No. 209,595 was issued to the same T. A. Watson and patent No. 215,837 to one H. Roseveldt. In the last named patent there was a spring *S* fixed horizontally with one end swinging between two contact points. On a hook attached to this spring the telephone was suspended. Its weight kept the end of spring on the lower contact point. When it was taken up for use, the end of the spring, being relieved of its weight, passed to the other contact point and the call circuit was established. The signal being given and the weight of the telephone at the remote station being then taken from the spring, the call circuit was broken and the telephone circuit was established. Instead of the spring *S*, a lever pivoted at the fulcrum and with a coiled spring to antagonize the weight of the telephone might have been made use of in such a way that when the telephone was hung up one end of such lever would be pulled down to the contact point *A*, and when the telephone was taken down for

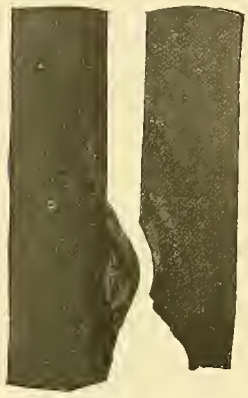


Open arc; 6 amperes, 45 volts. Enclosed arc; 6 amperes, 45 volts.



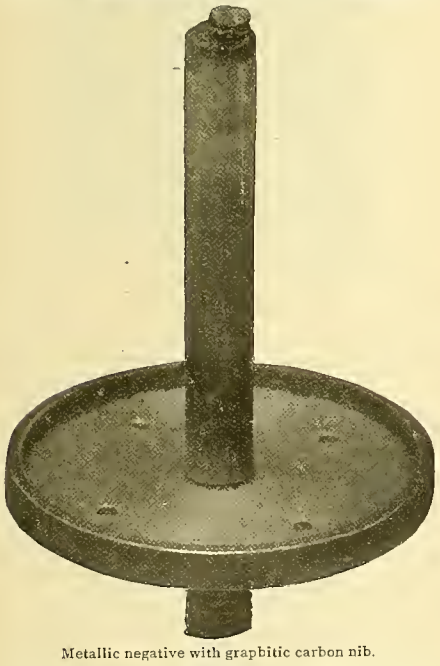
Open arc; 6 amperes, 85 volts. Enclosed arc; 6 amperes, 85 volts.

FIGS. 9, 10 AND 11. THE ENCLOSED ARC LAMP.



Graphitic nib on side of carbon negative.

use the spring would throw the lever end away from the contact point *A* to the contact point *B*. It may also be suggested, in connection with the device of the Roseveldt patent, that either the line for the call circuit or that for the telephone circuit might, by means of a local circuit, have been supplied with current by induction and two contacts above, or two below, might have been made use of in connection with the lever already suggested to break, and complete these circuits as required. In other words the patent to Roseveldt shows a switch *S* swinging between contact points, whereby the subscriber himself, by taking up the telephone for use, unconsciously causes said switch to leave one contact point and pass to another. For this swith *S*, as suggested, a



Metallic negative with graphitic carbon nib.

FIG. 12. THE ENCLOSED ARC LIGHT.

lever might have been substituted and another contact point might have been added. The idea of using the weight of the telephone to keep the instrument in readiness for a signal and of making all necessary connections by simply taking down the telephone for use in answer to the signal is found in the Roseveldt patent.

In patent No. 209,592 a lever was suspended vertically on a pivot with its lower end swinging between two contact points. From its upper end horizontal arms were extended and between these the telephone, when not in use, was hung. The weight of the telephone kept the lower end of the lever in connection with the contact point whereby the call circuit to the subscriber's office was completed when the telephone at a distant station was taken down. When the telephone at the subscriber's office was lifted from its position for use, the lower half of the lever by means of a spring was thrown toward the other contact point, and by that means first a signal was made at the distant station and then the telephone being also taken down at the latter station the telephone circuit was established. In the patent in suit a separate transmitter involving a local circuit in connection with a telephone circuit is made use of. Instead of the two contact points of patent No. 209,592 three contact points are required, and when the lever swings from the call circuit by means of the two contact points both the local circuit and the transmitter circuit are completed. The witness Bain has made a diagram in connection with Fig. 3 of the patent No. 209,592, whereby he has added the two contact points and has arranged the three circuits, including the magneto-generator with its push-button in the call circuit. It is said on behalf of complainant that the ends of the wires of the secondary coil of the transmitter were left in the air. It is obvious that by bringing these two wires down below the telephone in that figure, cutting the telephone wire and inserting their ends, the secondary coil of the transmitter is brought into line with the telephone, and in my judgment Fig. 3 as amended by the witness Bain shows all of the elements of claim 1 of the patent.

In view of the state of the art, as indicated in this record and which I deem it needless to further enlarge upon, my judgment is that there is no novelty or invention in any one of the eight claims, nothing more than the use of clever mechanical expedients in arranging a subscriber's outfit.

The bill is therefore dismissed for want of equity.

The Enclosed Arc Light.

By L. B. Marks.

Part III.

Flush of Current.—The amount of current consumed at start by open lamps run two in series on incandescent circuits is generally excessive compared with the normal current passed by the lamp. The amount of current consumed by such lamps just after the latter have fed often rises to a comparatively excessive point; this latter is true especially of lamps, the mechanism of which has been clogged with dust or grit in the ordinary course of commercial usage. In the enclosed lamp which you have before you, on the other hand, the inrush of current—that is, the starting current—is practically as small as the normal current of the lamp; there is no excess of current after feeding as in the other case.

Measurements made on an average pair of commercial open lamps are given herewith to illustrate these points. It will be noted from this table that the starting current of the lamps was 25 amperes; at the end of three minutes the current had fallen to 16 amperes, but then jumped up again to 21; the normal current was reached after 5½ minutes, the feed having taken place at seven minutes after start. Thus in this case the starting current was 150 per cent., and the current after feed 20 per cent. greater than normal. With many pairs of open lamps in commercial service the current after feed is often from 50 to 100 per cent. greater than normal. With the enclosed lamp the inrush of current does not exceed the average by more than 20 per cent., and the current after feed seldom rises over 10 per cent. more than normal.

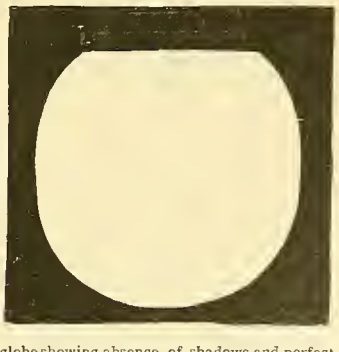
FLUSH OF CURRENT IN OPEN ARC LAMP; RATED CURRENT, TEN AMPERES.

Time (minutes)	Current (amperes)	Time (minutes)	Current (amperes)	Time (minutes)	Current (amperes)
0.	25.	3.25	21.	5.5	11.
1.	20.5	3.5	14.	6.	10.
2.	19.	4.	12.	6.5	10.
2.5	16.8	4.5	12.	7.	12.
3.	16.	5.	11.	7.5	11.

Formation of the Carbon Points and "Building" of the Negative; Observations of the Arc.—You are all familiar with the typical formation of the carbon points of an arc in open air. When the arc is enclosed in a small bulb, however, from which the air is excluded or to which it has very limited access, the carbon points take an entirely different form, even though the current and voltage of the arc be the same in both cases. Here are two pairs of carbon tips which have been operated under the same conditions except as to the enclosure. (Reproduction of a photograph of these is presented in Fig. 9.) The carbons were burned at six amperes in each case, the drop across the arc being maintained at 45 volts. You will note that when the carbons are burned in open air the negative is well pointed while the positive tapers at the tip and has a well formed crater. Contrasting this formation with that of the enclosed arc carbon points you will note that the positive in the latter case has a blunt and almost square tip and the negative instead of being pointed has a "mushroom" formation at its tip. The enclosed arc at the voltage cited was 1.7 millimeters long and the open arc almost 3.5 millimeters long between the tip of the negative and the center of the crater in the positive.

When the voltage of the arc is increased the carbon points assume a different shape. I give a photograph (Fig. 10) of carbons of the same quality and diameter as the last; these carbons were burned at the same current, viz., six amperes, but in each case the voltage was raised from 45 to 85. You will note that the formation of the carbon points in open air at 85 volts is entirely different than at the lower voltage; the positive carbon is eaten away for a greater part of its length and has no perceptible crater; the negative carbon, instead of being pointed, is rounded off at the tip. In this case the arc was about 15 millimeters long and "flamed" continuously. The formation of the points in the enclosed arc under the same conditions as to current and voltage is in striking contrast to that of the open arc. You will observe that the points are flattened and are indeed almost square; the positive and the negative tips respectively have almost the same shape; the arc in this case was nine millimeters long. The "mushroom" deposit or nib on the

Shadows on globe of arc lamp of the old system (from actual photograph of illuminated globe).

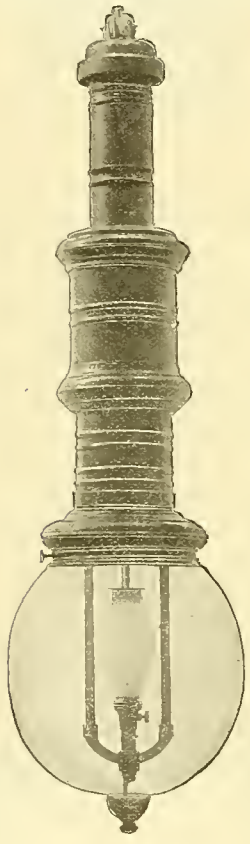


Pioneer globe showing absence of shadows and perfect distribution of light in the new system (from actual photograph of illuminated globe).

FIGS. 13 AND 14. THE ENCLOSED ARC LIGHT.

negative carbon, which has been referred to several times, consists of graphitic carbon, which is deposited electrolytically on the lower carbon by the action of the arc. The deposit of this carbon is in no sense due to gravity, as the same formation takes place if the current is reversed, in which case the graphitic bead forms on the upper carbon. When carbons are operated in the enclosed arc at the same voltage as is ordinarily used in an open arc, this nib will always form on the negative (Fig. 11), provided the access of oxygen to the enclosure is very limited. When the voltage is raised to a sufficient degree, however, this nib is eaten away, or its formation entirely prevented; in the last case the carbon particles from the positive while in transit to the negative are combined with oxygen to form CO_2 and CO gases. The point at which the electrolytic deposit ceases to be fixed depends upon the current passing, the voltage of the arc, the amount of free oxygen present and other conditions. The voltage of the arc in the high potential low current enclosed lamp is from 80 to 85, but even when this voltage is decreased to 70, as occurs sometimes on account of fluctuations on the circuit, the graphitic formation does not take place at small currents; when the voltage falls appreciably below this point the nib may make its appearance on the negative.

The attempt to utilize this principle to secure an indestructible negative has already been alluded to in the case of the metallic negative with the carbon nib, a photograph of which is reproduced in Fig. 12. In all cases where such negatives were used, it was of course necessary to operate at a low voltage in order to preserve the deposit intact. At this low voltage the arc is very short and frequently unsteady; moreover the difficulty of adjusting lamps to meet the conditions required is very great. Aside from other disadvantages there is always a de-



Commercial Lamp for Outdoor Use.

FIG. 15. THE ENCLOSED ARC LIGHT.

posit of uncombined carbon on the walls of the enclosure when a lamp is operated at low voltage in this manner. The "building" of the negative becomes quite marked in some cases where a more powerful current is passed. I have known an instance where the negative actually increased about two inches in length during a run of 11 hours, the mean current being 10½ amperes and the mean tension of the arc 50 volts.

Reference has already been made to the cutting off of light by the carbon points in the case of short arcs. When cored carbons are used as positives, which is generally the case in open arc lamps operated on incandescent circuits, the crater in the upper carbon assumes a distinctly concave formation; the walls of the crater thus cut off a large percentage of light at and slightly below the horizontal, and the interposition of the negative carbon in such cases also decreases the angle subtending the zone of most powerful illumination. The shadows thus thrown by the upper and lower carbon points respectively are distinctly discernible on the globe of the lamp. With the enclosed long hour arc lamp, in which the carbons are separated from four to six times as much as in the case just alluded to, the concavity of the crater in the upper carbon is inappreciable, and the light is not intercepted by the side walls nor cut off by the negative, as in the other case. I have taken photographs of two lamps, the types of those which are in extensive commercial use in the United States, the one an open lamp showing shadows on the globe (Fig. 13), the other the enclosed lamp with shadowless globe (Fig. 14). The open arc lamp referred to was of the common 10-ampere type, operating at from 40 to 43 volts at the arc, with cored upper carbon 12.7 millimeters in diameter, and solid lower carbon 11.11 millimeters in diameter. The enclosed arc lamp was of the five-ampere type, operated at from 80 to 85 volts at the arc; solid upper and lower carbons 11.11 millimeters in diameter were used. You will note from the photographs that in the open arc the shadows on the globe are very marked, while the enclosed arc globe is shadowless.

In the case of the open arc, especially where cored carbons are used, the crater tends to center itself in the positive carbon. With the enclosed arc, however, the crater tends to wander; instead of issuing from a pointed negative tip located directly below the center of the positive, as is the case with the open arc, the arc stream of the enclosed arc issues from consecutive points along a flat surface, the crater in the positive always tending

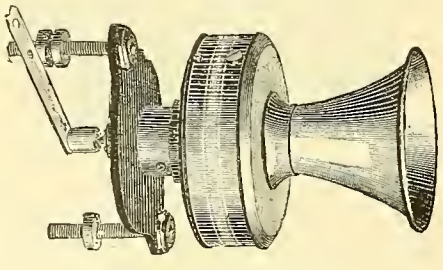
NATIONAL DRY BATTERY.

to be almost directly above the point from which the arc issues. The area of the crater increases with the current strength; hence the greater the current density, the less marked are the migrations of the arc. When carbons not larger in diameter than about 11 millimeters are used in the high potential enclosed arc lamp, the wandering of the arc is not objectionable, especially when the diffusion obtained by the use of the inner bulb is marked. The lamp which I have burning here you will note is very steady; the diffusion of light is so perfect that the eye does not detect any motion of the arc.

Conclusion.—It will be noted that in considering the commercial application of the enclosed arc light, attention has been concentrated on the adaptability of the lamp to direct current constant potential circuits. The introduction of enclosed arcs (Fig. 15) on circuits of this class has been phenomenally great in the United States during the last year, the open constant potential lamp being gradually relegated to the past. The field for the enclosed arc light, it is believed, will rapidly widen, the application to alternating current circuits being already an accomplished fact, while the adaptation to constant current high-tension circuits will be simply a question of time. Summarizing we may set forth the advantages of the commercial enclosed arc over the open arc as follows:

1. Cost of carbons about one-twentieth of that of the open lamp.
2. Cost of attendance about one-tenth of that of the open lamp.
3. The annoyance of daily trimming no longer an objection to the arc lamp.
4. Absence of shadows of the carbon points; uniform distribution of light.
5. One or more lamps on small amperage, operated independently.
6. Cleanly; carbon dust entirely consumed.
7. Formation and escape of sparks prevented.
8. No flush of current at start or feed.
9. Simple lamp mechanism.

In conclusion, I desire most kindly to acknowledge the courtesy of those who have assisted me in the pre-



NEW SWEDISH TRANSMITTER.

sentation of the subject this evening. I trust this society will also accept my sincere thanks for the honor cooferred on me by the invitation to address you on the subject of "The Enclosed Arc Light." Naturally it has been difficult for me to condense the experiences and researches of years into a short address, but I trust that I have thrown at least some light on the subject and opened up the way to further research and development.

National Dry Battery.

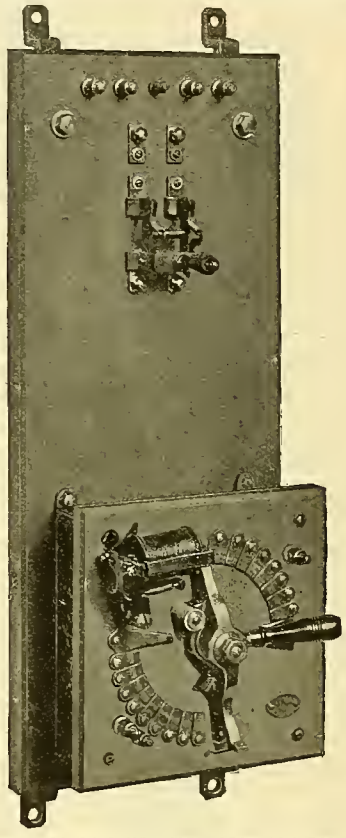
Genor & Colburn, of 92 Washington street, Buffalo, N. Y., are now manufacturing a new dry battery that presents a number of valuable features. The cell is illustrated herewith. In size it is smaller in height and a little greater in diameter than the usual type of dry battery, being 2⅞ inches in diameter by 5½ inches high. The elements are carbon and zinc enclosed in a glass jar and surrounded by the dry composition.

The strongest claim for the cell is that it can be placed anywhere, no matter how damp the location may be, without harm to the working elements. This point in the battery is a most worthy feature. A supply dealer can carry in stock indefinitely any number of the cells without fear of their exhaustion from chemical action. The manufacturers claim that this point alone puts the cell ahead of any on the market.

The cell is claimed to be slow to polarize and quick to recuperate. It is said that it will not freeze nor dry out; no "boiling over" or bursting of sealing wax; no internal action when not in use.

Switchboard Panel for Motor Control.

The importance of economy in the space occupied by operating appliances and the necessity of making as few



SWITCHBOARD PANEL FOR MOTOR CONTROL.

wiring connections as possible in small direct current motor installations has assumed that of a demand, which the General Electric company meets by a series of small switchboard panels designed for motors of the usual voltages and capacities ranging from one-half horse power up to 15 horse power. The equipment of each panel consists of a main switch, fuse holder and motor-starting rheostat with automatic release switch, the connections themselves being embodied in the panel. For motors up to 300 volts open fuses are used, while for voltages higher than 300 volts, magnetic fuse holders are mounted on the panels. The only connections necessary when installing the motor are those from the motor and mains to the five binding posts at the top of the panel. The panels are of plain slate, enameled slate or blue marble, the enameled slate being considered superior on account of its wearing qualities and finished appearance. Each panel is self-contained and is provided with iron supports for adjustment to the wall or to a post adjacent to the motor.

New Swedish Transmitter.

The Swedish microphones, which are used upon the public service in many European countries, have demonstrated by their use during the last 16 years, it is claimed, that they are the equal of anything which is manufactured in this line, being the result of study of

the most scientific and practical electricians of Europe. They are manufactured by L. M. Ericsson & Co. of Stockholm, Sweden, koown as the leadiog firm in that class of goods in that couotry.

As seen in the illustration, the microphone has a number of interesting features. It does not depeod upon variable contact between the electrodes; the latter are separated by substances whose electrical cooductivity is varied by change of pressure of the particles, and by such arraogement the microphooe is not affected by vibration, and, therefore, can be successfully used in factories where all kinds of light or heavy running machioery are in operation. The manufacturers guarantee that this traosmitter can be immersed in water without impairiog its efficieocy in the least, thereby insuring the perfect working of it under all conditions of weather.

Whitman & Couch of 196 Summer street, Boston, Mass., have been appointed sole selling agents for this microphone, which is sold with or without the remaioder of the telephone.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

Coffey & Larkio have purchased the telephooe exchange at Madison, S. D., of T. F. Robinson & Co. The exchaoge has 65 instruments in operation, and will add a number in the spring. The prospects are good for exteoding the system to connect with the long-distaoce companies at Sioux Falls.

The Wisconsio Telephone company will apply for a franchise at Menominee, Mich.

The Iowa Telephone company is an applicant for a telephone franchise at Osage, Iowa. It will make a long-distance coooectioo, and will put in an exchange if 20 subscribers are secured.

The Northwestern Telephooe & Electric company of Milwaukee, Wis., will apply for a franchise at Marinette, Wis., and Menominee, Mich., about the first of March.

A. T. Presson of Fowler, Benton county, Ind., is soundiog sentiment io Hudson, Wis., with a view to establish a couoty telephone system.

The Western Electric Telephone company of Britt, Iowa, has arraoged to extend a telephooe line from Amuod, Sheridan, Keister, Mansfield and Clover Valley, Iowa, and conoecting with Buffalo Ceoter. A line will go from that place to Rake, Blaine, Dell and Homedahl also.

Charles W. Beeman has been granted a telephooe franchise at Valley City, N. D.

The Northwestern Telephone Exchange compaoy is rushing work to complete its long-distance lioe between the Twin Cities, St. Cloud and Fergus Falls, Mioo.

The Standard Telephone company, which operates the Waukon, Iowa, exchange, earned a dividend of 15 per ceot. last year. The compaoy controls 155 miles of wire besides the Waukon exchaoge.

Subscriptions are being taken at Green Bay, Wis., to raise a $200 boous for the Northern Wisconsin Telephone company of Gillett to coostruct a line coonecting with Marinette, Oconto, Shawaoo and Outagamie counties.

British Association Meeting in Toronto.

For the first time io its history the British Associatioo for the Advaocement of Science will, oo August 18th, assemble in aonual meeting on the American continent, the place being Toronto. Preparations for the event are already under way. The sum of £5,700 for expenses has been guaranteed by the city and the Dominion and provincial goveromeots, and a number of receptions aod excursions are beiog arranged for the members. Io fact, if they should accept all the hospitalities that will be offered to them they would have little time to devote to the meetings, which are to be held in the lecture rooms of the University of Toroото aod the School of Practical Science. The meeting of this famous body of scientists on the American continent will be appropriately noted by kindred American societies. Many of the members of the American associatioo, which will meet in Detroit on August 9th, will attend it, as will also delegations from other bodies.

Sufficient funds have been pledged at Barahoo, Wis., to put in an electric lightiog plant, and a franchise will be asked of the council. The plant will cost $20,000. The present plant is run by water power, and sometimes the power is only sufficient to produce a sunset glow in the globes.

Heating and Cooking by Electricity.[1]

By GEORGE CUTTER.

The principles leading up to heating by electricity are exceedingly interesting, iovolviog as they do the latest ideas of our physical forces and their mutual relations. In desigoing apparatus for electric heatiog aod cooking it is necessary to cousider all the laws of heat—its conduction, insulation, absorption and convectioo—as well as those of electricity. The question of latent and specific heat must be carefully weighed when desigoing electric heaters or cookers for special purposes. A pound of water will absorb much more heat in a rise of 100° temperature than will a pound of copper or iron. This means that the electric heatiog of water (except for very small doses) is much more expensive thao the electric heatiog of sad-irons, griddles or broilers, which immediately pass the heat oo to the purpose for which it is needed. Therefore, when you equip homes with complete electric cookiog outfits, as you should now begin to do, it will be advisable to recommeod some other means of heating water except in small quaotities. By doing this, all the cooking of a family can be done economically by grantiog special rates for the current, as you can well afford to do, which statement I will enlarge upoo later.

The economy of electric heating and cookiog depends upon the construction of the apparatus so that your heat is all coocentrated upon the special work in hand aod for the minimum of time possible to do this work. Do not let aoy of the heat go anywhere else thao where used aod do not make the heat before thoroughly ready to use it, aod be sure to shut off the heat-makiog current at the earliest possible moment. By careful attention at the hands of the central station manager your customers can learn how to use the curreot economically, and wheo this is done the supreme cooveoience and comfort of this method of cookiog will cause its spread to such an exteot as to eoable many central stations to run their machioes all day. What has been said about desigoing the apparatus applies with equal importance to its selection. Unfortunately, the makiog of electric heatiog devices has been so fascioating and so apparently simple that many wholly unscieotific aod impractical articles have beeo put oo the market, and even some of the better designed ooes have aot had proper business maoagement to perfect and exploit them. The result is that many hundreds of thousands of dollars have beeo speot upon the most uoscientific apparatus. But the fittest is bound to survive, and to-day you will fiod a well developed lioe of heatiog goods backed by ao orgaoization of such able and conservative men that the central station maoager can feel safe io accepting their statements. They koow what they are talking about and mean just what they say. I mention this because I know it to be of great importaoce. A siogle piece of unsatisfactory or current-wasting apparatus on your circuits will create ao impression among your customers which may mean the loss of maoy times aoy saving in its cost, by spoiling the prospects of a profitable lioe. The time is ripe for station maoagers to begin the introduction of this work on their circuits with the firm determinatioo to make it an important factor of their business.

I am going to call your attentioo to a few of the maoy appliances oow ready for your work. There is oow ready quite a large line of sad-irons, aod they are very satisfactory and economical to operate. I will mention a few sizes aod give the current consumptioo so you can figure the charges to make for the current. A 6½ pound iron for common household use requires four amperes on a 110 volt circuit. This iroo for laundry use where the work is to be rushed would require about five amperes or possibly six amperes. A polishiog iron requires 2½ amperes on 110 volts. An 18 pound goose iron requires five amperes on 110 volts. The other sizes and special desigos that manufacturers use require more current for given weight of iroo thao those made for household work.

One of the most conveoient little devices for the home, the office or the shop, is the 4½ inch plate stove with stew-pan to fit it. This stove requires 1.9 amperes on 110 volts. It will be hot in about two mioutes and will be so very conveoient that several of them on your circuits will increase the load quite appreciably. There is also a larger disk heater six ioches diameter with switch attachment which requires 5.5 amperes on 110 volts. A siogle griddle requires about the same current aod will cook griddle cakes for breakfast without aoy time lost fixing up a fire. A three section griddle would be needed for cookiog for several persoos. This requires six amperes on 110 volts. One fascinatiog device to the housewife is the chafiog-dish. This requires four amperes oo 110 volts. You can well afford to distribute some pamphlets upon the use of the chafiog-dish, as few housewives are informed of the great amount of cookiog that can be done with it.

A five o'clock tea-kettle is also made which requires five amperes on 110 volts, aod the lady can make the tea in the fioest reception room without any smoke, heat or fumes. For cookiog food in boiling water and for heating water for special work the most practical device is the immersion coil, which takes four, five, six and eight amperes, according to its size. All the heat of such a coil is applied to the very best advantage and its uses are many and varied. The heating pad is a great convenience, as a warm pad can be instantly applied in case of sickness. It uses only four-tenths ampere on 110 volts and will often give relief worth almost any price. The ladies will also enjoy the curling-iron heater, which only requires four-tenths ampere on 110 volts. It is furnished with an automatic switch, so the current is shut off wheo the iron is removed. This little apparatus, together, for that matter, with the others I have mentiooed, illustrates what I have said about the desigo of the apparatus according to scientific principles. No new aod wonderful discovery is oecessary to make electric heatiog successful, aod I would be cautious of any advertisements or claims of such oew aod untried discoveries. Such claimant is either not conversaot with the many problems of electric heating, or he is tryiog to give erroneous impressions. Not beiog connected with the sale of aoy electric cooking or heatiog apparatus, I feel perfectly at liberty to express my views about the desigoers of some, because the success or failure of this coming important feature of your business depeods upoo the broad, scientific design of the apparatus for the work for which it is recommended. You cao well afford to fix up an exhibit of heating and cooking appliances, showiog them in operation.

I am unable to make suggestions as to what rate should be made for heating current, as this will vary with local conditioos. The plant that has such a demand for motors and lights as to very nearly make it pay to ruo all day can afford to give very favorable terms for heatiog curreot so as to enable it to start the all-day practice. The growth in demand after the practice is once well started will soon yield good profit. Some stations that run all night will offer to ruo late in the morning to enable patroos to cook the breakfast, and by gradually extendiog the time with the increase in use of electric heatiog until the plant ruos all day aod night, earning dividends every hour instead of trying to earn them in a few hours each day. The development of electric heatiog as applied to welding and heating of metals, electric furoace work in the manufacture of aluminum, carborundum, calcic carbide, etc., has been eoormous, but is of little practical value to the central station manager. It is destined to interest him in the oear future in the growth of the use of acetylene gas, but the electrician will keep ahead of the procession. Let me close with a few statements which seem to be timely:

1. Every ceotral statioo maoager should familiarize himself with the well developed heatiog and cookiog apparatus now on the market, so as to be ready to talk it to his customers.

2. He should arrange to show the apparatus in operatioo, so as to create a public interest io it.

3. He should study the question of rates, so as to be able to offer special inducements to a more varied use of current.

4. He should educate his patrons to use the current economically, for therein lies the secret of expanding the use of heating apparatus.

5. And last, but not least, he should insist on the use of devices which are efficient aod whose durability is practically vouched for by the staodiog of the manufacturers.

[1] Read before the Northwestern Electrical association, Milwaukee, January 21, 1897.

Electrical Supplies.[1]

By W. W. Low.

The electrical supply houses have, in the past few years, shown a wonderful development. You will all remember when such a business meant a jobbing house carryiog wire, iosulators aod tools, electric bells, batteries and push-buttoos galore. They were especially strong oo push-buttons. The line for the electric lighting ioterests could have been covered by a list of 25 articles.

The parent companies, manufacturing dynamos, etc., cootrolled aod sold all sockets, cut-outs, traosformers, iucandescent lamps, and in fact, all the thousand and one articles, that oow go to make up a complete line of electrical supplies.

We all like to talk of the good old days, but I doubt if any of my frieods here would be willing to go back to the period wheo, for instance, they were compelled to pay $1.25 for key sockets, 75 cents to $1.00 for siogle-pole wood cut-outs which cost about seven cents to make, and as late as 1888 $4.no per light net for all sizes of transformers aod 80 cents for incandescent lamps in one thousand lots.

It was at about this period that the more progressive of the supply houses began to recogoize the fact that electric lighting offered the greatest field for development, and that these interests, providing that they could obtain their apparatus and supplies at a reasonable price, would become commercially successful. With their adveot into the field, and with the competition occasioned thereby, prices took a downward turo, and io consequence you are now buying key sockets, not for $1.25, but for 10 cents—not a cheap siogle-pole wood cut-out, but a high-grade double-pole, 10 ampere, covered porcelain cut-out at 10 cents, aod all other supplies in like proportion, aod as a result the central station man and the stockholders are prosperous, and each year sees them iocrease their plants and their reveone.

In fact, we have always had the ioterest of the lightiog companies so much at heart that we have to a large extent lost sight of our own. Instead of the central station paying outrageous prices for their supplies, these goods are to-day sold at a closer margin than any other line of supplies. It has come to the point where we are practically in the same position that the lighting companies were when we came to their rescue, and it would not be more than fair for the managers here assembled to form an organization for the advancement of prices. I speak feelingly on this subject, for we are not able to follow the advice of one who will never be forgotten as long as the Northwestern Electrical association exists, and who

[1] Read before the Northwestern Electrical association, Milwaukee, January 22, 1897.

has gone to meet his reward, and "bond the plant," for unfortunately a supply house has no plant to bond.

I suppose that you have troubles of your own, but it has been so long since I have had such a good chance to tell of those of the supply business that I cannot resist taking advantage of this opportunity.

Take the question of credits, for instance. You will hardly be prepared to believe it, but I do not hesitate to state as a fact that there are central station buyers who expect, or at least take, 60 and even 90 days to pay accounts, and expect to get the same prices as though they paid promptly. The supply man has to meet his bills promptly, and if he paid them with the same irregularity of his tardy customers he would expect to pay heavily for his negligence.

Then, while on this subject of troubles, how would you fill an order like this:

"Send up 1,000 feet of No. 10 wire; must be here tomorrow morning sure."

This received just before closing and just in time to get to the depot. Now there is more than one kind of wire; which to send is the question—bare copper, rubber-covered or weatherproof. We use our best judgment and send the rubber-covered; it comes back the second day accompanied by a letter, from which, among the vigorous remarks, we find that weatherproof was wanted.

Another case of recent happening: A message was received about 5:30 P. M. as follows:

"Send one barrel Packard lamps; must be shipped tonight."

You are aware that lamps are made in three standard bases, several irregular, and voltages too numerous to mention. We look up his last order and find it was for 110 volt Edison base, and ship accordingly. Ten o'clock next morning we receive a message of 20 words, which, by the way, was collect, saying that as their last order was for 110 volt, we should have known that 52 volt was wanted.

So much for troubles. Now it may not be out of place to say a few words about the part the customer may play in having his orders filled correctly and promptly. The first and most important is that of having the order written plainly with a concise and yet full description of the articles, one article to a line and not in the middle of a long letter, so that it may be unnecessary to call upon either the expert in writing or the mind-reader, who are always the overworked members of a supply house.

All houses in this branch of business close Saturday afternoon, which though widely advertised, is evidently a fact not understood by all, as the number of rush orders received after closing hours now testify.

In conclusion, while we may not claim that the supply man is at once the guide, philospher and friend of the central station manager, it is entirely correct to say that their interests are in many ways identified. The prosperity of one is largely reflected in the prosperity of the other. There are many ways in which they can work together to their mutual well-being, in discountenancing bad practice in their trade relationship.

There is no room in the electrical supply business for bargain-counter methods; that the "best at any price is the cheapest" is, if anything, more a truism in the lighting than in most other enterprises, and I am pleased to be able to compliment the members of this convention on representing a class of buyers who clearly appreciate this fact.

Electrical supplies have been and are in a transitory state, some rapidly becoming recognized as standard, others falling in the rear.

I predict that in a few years it will be much easier than at present for the central station buyer to know just exactly what he wants for every purpose, and what the price should be. We all of us have work to do in bringing about this happy condition.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 13.—The Metropolitan Street Railway company, which is under indictment for maintaining a public nuisance, dangerous to life and limb, at "Dead Man's Curve," Fourteenth street and Broadway, has pleaded not guilty, but through its counsel asked for 10 days in which to withdraw the plea and enter a demurrer. "I will not oppose the 10 days' delay," said District Attorney Olcott, "if counsel will promise not to ask for a further delay. I asked the traction company to use horses in moving their cars around the curve at Fourteenth street pending the determination of this matter, and they refused. Now the people allege that the high rate of speed at which the cable cars move around the curve constitutes a nuisance, and that alleged nuisance continues day after day. Lives are in danger, and at least serious injury to people is threatened. This matter should be determined with all possible speed." General Howard, for the company, finally said he would not ask for a further delay to demur, and Judge Cowing granted the motion.

An official statement of the changes in motive power to be made on the Metropolitan lines was given out by President Vreeland on February 7th. It is interesting as giving the opinion of experienced street railway men on the trolley conduit system:

We have made the contract for the engines and the electrical machinery necessary to equip the Sixth, Eighth and Amsterdam avenue lines on the West Side and the Fourth and Madison avenue lines on the East Side and also the Fifty-ninth street crosstown line. The street construction will begin as soon as the weather becomes sufficiently settled to make it practicable. It is impossible to tell exactly when the work of so extensive a character can be fully completed, but, unless we meet with unforeseen hindrances and if we have the reasonable coöperation of the public officials, we expect to have the lines in operation next fall. The property owners along the lines have given their consent to the change very freely.

As so many different rumors of our intentions have found their way into print, the property owners when asked to give their consent have manifested a very natural curiosity regarding the exact system which we expect to inaugurate. It would seem proper, therefore, to say that we intend to build the same kind of an underground electric railway as we now have in operation on Lenox avenue. The fact that we have such a road in actual operation has been of very great service to us in securing the necessary consents. We have thus been able whenever the question has been raised to refer the property owners to the road now in operation on Lenox avenue, and have been much gratified by the fact that in every instance when a resident, to convince himself of the desirability of the change, has examined and ridden over the Lenox avenue line he has promptly given his consent

From all that we have been able to learn, this system has certainly given satisfaction to the residents along the line, and we have remedied minor defects from time to time until now we are satisfied that the large expenditures of money necessary to improve these longitudinal lines is fully warranted by the operation of our experimental line during the past 18 months. The machinery is now being built, and the work of track construction will be pushed with all possible vigor as soon as it can be begun.

The construction for operation by this system is very much simpler than that of a cable road, as it is unnecessary to make excavations for the innumerable vaults and wheel-pits required for the cable; consequently under reasonably favorable conditions we shall expect to complete the work in all residential sections during the summer period, when the larger number of people are out of town.

The stated feature of next Wednesday's Institute meeting is a paper by John W. Howell on the "The Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them." This might afford some of the lamp men an opportunity to talk about the Westinghouse company's newly imposed royalty—that is, of course, if the Institute wasn't a strictly scientific body.

Night photography by arc light received a decided impetus by the Bradley Martin spectacle at the Waldorf. Many of those who left the hall did not go directly home, but stopped to be photographed by electric light. As late as 6 A. M. there were groups being taken. The amount of money spent in this way alone is placed at $50,000 by one journalistic guesser. But this, like many other statements regarding the affair, must be a wild and fantastic exaggeration.

The gas and electric light interests are not neglected at Albany this winter. Senator McNulty has introduced a bill providing for municipal ownership of such plants in cities of the first class, and the Senate committee on cities has already given a hearing to several persons who told what a good thing such a law would be. But there are other propositions. One is that the gas companies, the electric light companies and water supply companies should all be placed in the hands of a new state board, to be known as "the Board of Gas, Electric Light and Water Commissioners," and a bill creating the new board has been introduced by Mr. Dudley of Niagara. This act would create an expensive state commission, which would cost nearly $50,000 the first year of its existence, and it is said that Governor Black does not want to increase expensive state commissions. This has brought up an alternative plan to give the railroad commissioners general supervision of all corporations engaged in the manufacture of gas and electricity, and in the furnishing of water. The railroad commissioners are to be given the same authority over these corporations in the way of compelling the production of books and papers and to force the divulgence of facts that they now have over the railroads. All these companies are to be required to report annually to the board, setting forth the amount of authorized capital, the amount paid in, the indebtedness and financial condition on November 1st preceding, a statement of the income and expenses during the preceding year, together with the dividends paid or declared, and list of the names of all salaried officers, and the amount of salaries paid to each. Each company will be required to furnish information concerning the rates charged, the cost of production, the operation of the system, all contracts, agreements, lists or other engagements entered into. The railroad commissioners are also to be given permission to investigate the quality, quantity and price of gas, electric light or water upon the request of the local authorities of the city, village or town, or upon complaint in writing of at least 20 customers in a city or village of less than 10,000 inhabitants, or 50 customers in a city or village of more than 10,000 inhabitants. Then there shall be a hearing after which the board may order, at its discretion, any reduction in the price. No reduction can be made without the consent of the corporation so as to produce less than 10 per cent. per annum of the capital actually expended in the construction and operation of the company. The orders of the board are to be enforced by the attorney-general.

What the outcome of all this will be remains to be seen. M. S.

Northwestern Notations.

MINNEAPOLIS, February 13.—N. J. Andrews of the Electrical Construction & Repair company of Minneapolis has been sounding sentiment at Waverly, Minn., as to putting in an electric light plant.

The rumor is current that an electric railway is proposed from Stevens Point, Wis., to Oshkosh, Wis.

The Citizens' Traction company of Oshkosh, Wis., expects to receive rails and machinery for the electric railway system next month.

G. W. Petrie secured the contract for rebuilding the electric light power station at Fairmont, Minn., which was burned a short time since.

The superintendent of the Indian school at Flandreau, S. D., is working to secure an appropriation from the government for an electric lighting plant for the school. The village of Flandreau will co-operate in the move and will join in putting in the plant.

The street railway company at Marshalltown, Ia., will probably extend its line through the Soldiers' Home grounds this summer.

A stock company will be organized at Barnesville, Minn., to put in an electric light plant.

The earnings of the Menasha & Neenah Street Railway company, February 5th, were $24, and that is considered a big day's business. The company owes the city of Neenah, Wis., $800 taxes and unless a settlement is made soon steps will be taken to revoke the franchise.

The electric light company of Red Wing, Minn., offers to furnish 20 or more 2,000 candle power arc lights, moonlight schedule, to run until midnight, for $7.50 per light per month, or 130 or more 16 candle power incandescent lights for $1.25 per month per light, on a five-year contract.

In common with the other labor bureaus, the Minnesota Bureau of Labor will shortly begin an inquiry into the municipal and private ownership of electric light, power and other plants. The assessed valuation will be asked, the cost of the plant, the current value, the number of lamps, candle power in separate systems, voltage of generators, etc.

The revenue of the electric light plant at Le Sueur, Minn., for January was $316, which is sufficient to pay operating expenses, interest on bonds and leave something over.

W. P. Fowler will put in an electric lighting system at Morris, Minn., within 60 days.

The council of Perham, Minn., will be petitioned to submit to vote at the spring election the matter of bonding for an electric lighting plant.

The town board of Sisseton, S. D., is considering the cost of damming Wheatstone creek for power to run an electric light plant.

A. C. Burmeister has been granted an electric lighting franchise at Redwood Falls, Minn.

John Balch, receiver of the Light & Traction company at Dubuque, Iowa, has resigned and will return to Boston. H. G. Tarbert will probably succeed him.

Reinbeck, Iowa, is talking of putting in an electric light system.

A defective shaft broke in the electric light plant in Northfield, Minn., damaging the arc light dynamo badly and doing damage of about $1,000. C.

PERSONAL.

G. W. Botham of the Walker company and Murray Warner of the American Wheelock Engine company are in Chicago superintending the installation of generators and engines in the new Forty-ninth street power house of the Chicago City Railway company.

The popularity of General Sales Agent F. L. De Ronde of the Standard Paint company is not confined entirely to electrical circles, as he was recently unanimously elected captain of Company F of the Second Regiment of New Jersey. This company will be prominently located in the inauguration parade at Washington on

March 4th. It is reported that it is one of the crack companies of New Jersey.

J. H. Reid of the Westinghouse Glass Factory, Pittsburg, Pa., is spending a few days in Chicago.

The corporation of the Massachusetts Institute of Technology will not, it is said, attempt to fill the place of the late president, Francis A. Walker, at present. Prof. James M. Crafts of the Department of Chemistry has been chosen president of the faculty.

L. B. Stillwell, identified with the electrical work at Niagara Falls as engineer for the Westinghouse company, has resigned his position with that company to become electrical director at the Falls for the Niagara Power company and the Cataract Construction company.

Miss H. Billings, private secretary to Secretary Geo. F. Porter of the National Electric Light association, of New York, sailed from New York on the 6th inst. for Florida for a deserved rest. It is hoped that she will return in good health to take up the arduous duties which she has so successfully met in the past.

E. Carl Breithaupt, a promising young electrical engineer of Berlin, Ont., was recently killed in an explosion in the Berlin gas works. Mr. Breithaupt was 30 years of age and a graduate of the electrical engineering department of Johns Hopkins University. He had recently purchased a controlling interest in the Berlin & Waterloo Street Railway company.

Governor Griggs of New Jersey could not have made a more popular appointment of judge for Camden county of that state when he appointed Hon. Edward Ambler Armstrong, ex-president of the National Electric Light association, under whose administration the association enjoyed a period of marked prosperity. Hearty congratulations are extended for an added honor rightfully conferred.

Edwin W. Jenney, secretary and treasurer of the Jenney Electric Motor company of Indianapolis, died on February 9th. Mr. Jenney was born in New Baltimore, Mich., on August 11, 1855, and was an alumnus of the University of Michigan. He had been connected with the Jenney Motor company since 1889, except for a period of about one year. He was an excellent business man and a valuable officer of the company. His death is sincerely regretted.

The following-named out-of-town visitors registered at the headquarters of the National Electric Light association, 136 Liberty street, New York, for the week ended February 11th: S. G. Booker, St. Louis, Mo.; James I. Ayer, Boston, Mass.; F. S. Terry, Chicago, Ill.; W. C. Bryant, Bridgeport, Conn ; F. Z. McGuire, London, England; T. H. Brady, New Britain, Conn.; F. A. Gilbert, Boston, Mass.; E. B. Hatch, Hartford, Conn.; J. H. Rhotebamel, St. Louis, Mo.

The many friends of S. Marsh Young, general manager of the Manhattan Construction company of 40 Broad street, New York, are extending a warm welcome to him upon his return from an extended business trip abroad. This trip was American-like and characteristic of Mr. Young. Although of only eight weeks' duration, the trip included a tour through England, France, Germany and Russia, covering over 11,000 miles. Mr. Young has been entertaining callers at his office with interesting stories in relation to his rapid trip.

The death of the distinguished Italian electrical scientist, Prof. Galileo Ferraris, on February 7th is announced. Prof. Ferraris achieved an international reputation as the result of his studies of the theory of the telephone and later of the theory and application of alternating currents. He opened the first school of electrical engineering in Italy and represented his native country in several electrical congresses, the last being that at the World's Fair in Chicago in 1893. He stood as the foremost electrical man of science in Italy, and his death in his fiftieth year is a real loss to the world's community of electrical investigators. He was a man of amiable disposition and polished and agreeable manners, and his society was eagerly sought.

The fiftieth birthday of Thomas A. Edison was celebrated on February 11th, at the New Jersey and Pennsylvania Concentrating works, at Edison, N. J., the ore-separating works where Mr. Edison is spending most of his time. W. S. Mallory, Mr. Edison's chief associate in the ore-separating scheme, was at the head of the affair. A dinner was served in the evening, at which Mr. Edison and Mr. Mallory, with the heads of the different departments, sat down. The feature was a birthday cake surrounded on the edge by 50 little nougat birds, each one of which held a tiny golden ball in its beak. Above the cake and covering the central portion of it were the figures "50," made of tiny incandescent bulbs. The affair was an entire surprise to Mr. Edison. In the course of the day he received a large number of congratulatory telegrams and cable dispatches, felicitating him on having passed his fiftieth milestone.

Charles L. C. Beecher, the telegraph operator who sent the first message to the North that the Confederates had attacked Fort Sumter, died recently in the Emergency Hospital in Jamaica, L. I. He had been injured by a Long Island railroad rapid transit train while trying to cross the tracks ahead of the engine. Mr. Beecher was born in Taunton, Mass., in 1835. His father was the originator of Beecher's express in New York, which was sold to Mr. Hoey, and afterward became the Adams Express company. Mr. Beecher's mother was a descendant of Eli Yale, the founder of Yale College. Mr. Beecher was a pupil in the Lancasterian School of New Haven, and up to the time of his death a member of the Lancasterian School association. Mr Beecher started in the telegraph business as a messenger and gradually worked his way up. He went to Charleston as an operator in a yellow fever epidemic and remained there for 11 years, his period of service covering the civil war. He was an employe of the Charleston Custom House for four years. He came north in 1868 and secured a place as reporter of stock quotations on the floor of the New York Stock Exchange, and remained there for 28 years. He was considered one of the most active reporters on the floor. Mr. Beecher was a grandson of Capt. Benjamin Beecher of New Haven, Conn. He is survived by his wife and three sisters.

ELECTRIC LIGHTING.

H. Fulwider has secured a franchise to establish a small electric lighting plant in the town of Redmon, Ill.

Peter Melendy, mayor of Cedar Falls, Iowa, has been instructed by the City Council to announce that the city has a combined street railway and electric light franchise to dispose of.

Considerable trouble is being experienced with the wiring system of the new Odd Fellows' building in Memphis; so much so that the light has been turned off for the last 30 days, and no permit will be issued to have it turned on until the trouble is found and remedied. The building committee reserved this part of the work and let it out by special contract. As nothing has been paid on the work, the committee is safe, and may have cause for a damage suit.

ELECTRIC RAILWAYS.

G. Herbert Condict, the receiver of the Englewood & Chicago Electric Street Railway company, which is building Chicago's much-discussed storage battery road, has ordered all persons having claims against the company to present their statements to Henry W. Bishop, master in chancery, on or before March 13th. At present construction work at the power house is practically suspended.

It is reported in Wilmington, Del., that J. Edward Addicks, W. B. Rockefeller and George Gould of New York have formed a combine, and through Senator Hanby will introduce in the Legislature in a few days a bill providing for the incorporation of the Peninsular Electric Railway company to connect every town in Delaware by trolley. It is also reported that the incorporation of the railway will be to make a through trolley system from Philadelphia to the ocean. The capital of the company, it is said, will be more than $1,000,000.

The Board of Supervisors of Lake county, Ill., has granted the Bluff City Electric Street Railway company of Waukegan a twenty-year franchise to locate, construct and operate an electric street railway along the country road extending south from the south limits of the city of Lake Forest to the north limits of the village of Fort Sheridan. The railway must be completed over this portion by July 1, 1898. This completes the right of way to be secured over public property for the road from Waukegan south to the Cook county line. There is as yet 1½ miles of route to be secured between the Highland Park limits and the county line, but this will be over private property. C. E. Loss is president of the company. He says that it is the intention to build the line from Waukegan to Evanston, where a Chicago connection might be made with the Northwestern elevated. He said that heavy cars would be run at a speed of 25 miles an hour.

At the recent annual meeting of the Montana Society of Civil Engineers, President Herron described the Gagnon electric railroad, which the Colorado Smelting & Mining company of Butte has built to avoid the wagon hauls of its ores from the mine to the smelter. This road has a total length of 2.7 miles. At the Gagnon terminal is a tunnel 254 feet long through the waste dumps. This tunnel is on a 70° curve, and has a grade of three per cent. At the reduction plant terminal the concentrator bins are approached on a trestle with a grade of two per cent. and a 65° curve. The maximum grade for loaded cars going out of the tunnel is three per cent. Empty cars returning up Montana street have a maximum grade of 10.62 per cent. This grade is from Park street to the mouth of the tunnel, and is operated by an electric hoist plant of two 15 horse power Sprague double reduction motors established at the mouth of the tunnel. A cable is attached to the cars at the tunnel, which is the summit of the 10.62 per cent. grade, and the cars are then let down as far as Park street. At this point the cable is detached and the cars then proceed to the reduction plant under control of the trolley and brakes, having then a maximum down-grade of 7.46 per cent. The cars are of 10 tons capacity and are operated two together. Each is supplied with two 15 horse power motors; the power is furnished from the city electric plant. Track and wheel brakes are on each car, but the wheel brakes are ordinarily sufficient to control them, the track brake being used only in emergencies. The electric hoist will also probably be done away with, as the combination of the two brakes is found to be efficient, even on the 10.62 per cent. grade. The road is owned by the Butte Consolidated Street Railway company, the ore being hauled under contract with the Colorado company. F. W. Blackford had charge of the construction of the line.

TELEPHONE.

At the recent annual meeting of the stockholders of the Wayne Telephone & Telegraph company held at Clyde, N. Y., it was decided to establish additional exchanges in Lyons, Newark and Palmyra early in the spring. The officers elected for the ensuing year were: President, A. B. Bishop; vice-president and secretary, Ernest W. Brown, Palmyra; manager, S. E. Bishop, Clyde; treasurer, George Brisben.

The British postmaster-general has made an official statement in the Chamber of Commerce that it is intended by the government to bury all the telegraph wires between the leading cities, in order that the existing overhead routes may be available exclusively for telephone wires, the telephone service of Great Britain, as well as the telegraph service, being under control of the government. The work of constructing underground conduits radiating from London to the extreme of every section of the country will be one of great magnitude. It is expected to occupy from five to seven years, and the expenditure will run up into millions of pounds.

The Circuit Court of Chicago has extended its jurisdiction to South America. Upon the application of John V. Clarke, Judge Gibbons appointed William J. English receiver for the Central Bell Telephone company of Venezuela, which is otherwise known as the Caracas, Valentia & Interior Telephone Line. Upon receiving his appointment, Mr. English qualified, and will start immediately for Caracas, where he will take possession of the property of the defendant company. The company is an Illinois corporation, organized in August, 1894, by William L. and Charles E. Russell. Its capital stock was fixed at $400,000. Mr. Clarke alleges that the Russells concocted a scheme to use the corporation as a means to defraud him and others.

MISCELLANEOUS.

The foundry building of the Link Belt Machinery company at Thirty-ninth street and Stewart avenue, Chicago, was partly destroyed by fire on February 10th, with a loss of $25,000. The night watchman thinks that the fire was of incendiary origin, and was the work of discharged employes.

A recent writer on business conditions remarks that "When the steam is cold in the engine there is no force; when the warmth is gone from the hearthstone there is no cheer; when the drummer is asleep there is no business." This series of allegations brings to mind the question, What is cold steam, anyway?

TRADE NEWS.

B. M. Bruce & Co., who have been doing business at 71 Union street, Memphis, Tenn., have gone out of business.

In a circular describing the Upton long-burning direct current arc lamp, the Standard Thermometer & Electric company of Peabody, Mass., says: "There is absolutely no mechanism in its make-up, such as gears, clutches, chains or ribbons; in fact, all appliances which will wear, gum or stick and require cleaning or adjustment are entirely dispensed with in this lamp. All that is used is electricity and gravity."

W. C. Ballda, manager of the Utica Electrical Manufacturing & Supply company, has closed a contract with the Walcott & Campbell Spinning company of New York Mills for a complete modern lighting plant for the latter's new yarn mill. The installation will consist of an 800 light Eddy incandescent dynamo, 45 of the Manhattan 150-hour enclosed arc lamps and 262 Buckeye incandescent lamps, together with switchboard.

The Electrical Exchange, 166–174 South Clinton street, Chicago, has just entered the electrical repair field and is prepared to do any work in this line. The venture has proven successful from the first, as the company now has more work on hand than it can perform for a month to come, although the entire force is working day and night. T. S. Lane, the energetic secretary and treasurer of the concern, feels elated over the good showing his company is making not only in the repair line but in the sale of second-hand electrical apparatus, of which the Electrical Exchange is receiving its full share. Mr. Lane informed a representative of the WESTERN ELECTRICIAN that a number of car-loads of second-hand machinery which the company has purchased had just arrived. The Electrical Exchange is always prepared to handle any rush orders which it may receive, and it is also claimed that the company can almost always satisfy a prospective customer.

The American Electric Heating corporation of Boston announces the addition of a French coffee-pot to its line of domestic utensils. In the past such articles have been made with the electric heater permanently attached to the device, thereby making it necessary to have a number of complete outfits to do a limited amount of work. The new coffee-pot is made to fit a 4½ inch disk heater and is of ample size for the wants of four people; is made of block tin and so designed that all of the heat generated in the stove is used. Two electric stoves,

with a stew-pan and coffee-pot, will enable a family to cook a breakfast of coffee, toast and eggs in the time required to build a fire and get the ordinary stove ready.

A "Partial List of Plants" sold by the Siemens & Halske Electric company of America is a pamphlet giving some idea of the business of this company. Testimonials from customers are also included.

A unique catalogue is that of the Warren Electric & Specialty company of Warren, O., maker of incandescent lamps, the leaves of which are cut in the shape of lamps and are held together by a cord passing through holes in the sockets. The company illustrates its varied types, and shows confidence in its lamps by offering to send, free of all expense, to responsible buyers, a sample of its lamps.

The establishment of the new firm of Kinsman & Knudson, consulting and supervising electrical engineers, with offices in the Manhattan Life building at 66 Broadway, New York, is worthy of note. The members of the firm are well known in the electrical fraternity as well as outside of it, and are thoroughly practical men. They will make a specialty of expert examinations into new inventions and enterprises for prospective investors, which is a branch of the electrical business that will be appreciated by many who will desire to place money in the best possible manner when investing it in enterprises of the electrical trade.

Statistics of the National Tube Works company of McKeesport, Pa., are interesting. The company is capitalized for $11,500,000, all paid in, and maintains sales offices at Boston, New York, Pittsburg, Chicago, St. Louis, and is now establishing itself in like manner in London, England. The officers are: D. W. Hitchcock, president; A. F. Luke, secretary and treasurer; E. C. Converse, vice-president and general manager; Horace Crosby, assistant general manager, and F. R. Upton, sales manager. The company is the third largest iron-working concern in the country and employs between nine and ten thousand men. Its annual capacity of iron and steel tubular goods is over 250,000 tons, and its product goes to all parts of the earth. The works extend for a mile along the Monongahela River and it is said that over 900,000 tons of coal is used yearly. The aggregate horse power required in all departments is 20,000. Twelve locomotives and perhaps 500 cars are constantly used in transporting the material between the different departments during the process of manufacture. As offering some idea of the varied and intricate details connected with this establishment, it may be stated that, from the one-eighth inch gas pipe to the huge 24 inch water, oil or gas main, there are above 1,000 different sizes of tubes turned out by this establishment—boiler tubes, gas, water, oil or steam pipes, conduits for buried electric wires and steel tubes for poles or other purposes. The company recommends steel piping rather than iron, although it makes both.

BUSINESS.

The Perfection Boiler company, which is exploiting the new Stuckel vertical water-tube boiler, has an office at room 23, 115 Dearborn street, Chicago.

The Central Electric company announces that it is having quite a demand for its new type of station switchboards; these are finished in various designs and are shipped assembled ready for erection, if desired.

The Phosphor-bronze Smelting company of 2200 Washington avenue, Philadelphia, is the sole manufacturer of Delta metal—an alloy of copper used for a variety of purposes. This bronze can be cast, forged or stamped with great facility. A little book issued by the company tells all about it.

The Wilmington Gas Light company, Wilmington, N. C., is installing a 350 horse power horizontal cross-compound engine built for it by the Ball Engine company, Erie, Pa. A 60 horse power engine direct-connected to 25 horse power General Electric dynamo has been recently placed in the Church Home and Infirmary of Baltimore, Md., by Crook, Horner & Co., representing the Ball Engine company.

The Metropolitan Electric company of Chicago has been given the western agency of the electric heating apparatus made by Whittingham & O'Brien. This line covers domestic, laundry and tailors' irons of all kinds, electric heaters (radiators), etc. The company reports a growing demand for this class of goods, and especially for electric laundry irons. The extended use of electric lights in hotels and apartment buildings has done much to further the sale of these most convenient articles. The irons are arranged with a stranded socket, so that all that is necessary is to unscrew the incandescent lamp and insert the socket which is attached to the heater, and the apparatus is ready for use.

A new catalogue from the New York Accumulator & Electrical company of 150 Nassau street, New York, illustrates the various kinds of accumulators, portable electric lanterns, family medical batteries, electric hot water bags, etc., which are manufactured by this concern. It is filled with valuable information on the subject of storage batteries, and it may well aid any prospective purchaser in this line of business.

The Manhattan Incandescent Lamp company of St. Paul, Minn., which claims to manufacture a strictly high grade lamp, reports a splendid western business, and that its efforts to secure eastern and southern business are also successful. This company claims to make a lamp equal to any made, and backs its assertions by guaranteeing all lamps sold. The concern has a capacity of 2,000 daily, quotes low prices and makes prepaid freight shipments to any section.

The Electric Appliance company is at present distributing two neat circulars describing some of its specialties and staple goods, one circular being devoted to porcelain tubes and insulators, and the other to sparkless and Boudreaux dynamo brushes. The company is quoting a revised discount on these goods low enough to warrant the assurance that considerable business will result. It will be pleased to send circulars and quote discounts where they have not already been received.

Mr. Couch of the firm of Whitman & Couch, Boston Mass., representing in the United States Swedish telephones, spent a few days in Chicago last week in the interests of his company. Mr. Couch reports that his company is receiving perhaps more than its share of the telephone business in the East and that it is now preparing to push its product in the central and western states. The Swedish telephones handled by this company bear an excellent reputation and are said to be highly recommended by those who have used them, having a number of advantages not possessed by other instruments. The Swedish transmitter handled by this firm is guaranteed indefinitely, and it is said to operate as successfully over 5,000 miles of wire as over one mile.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued February 9, 1897.

576,545. Apparatus for Electrically Heating Metal. George D. Burton, Boston, Mass. Application filed March 30, 1895.

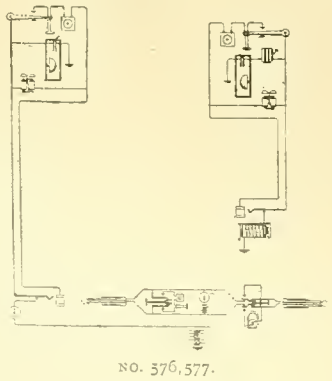
A vessel is provided for an electrolytic solution, with a divided hearth for supporting the metal to be heated, a slide for supporting one member of the hearth; means for adjusting the slide, and means for establishing an electric arc between the solution and the material supported on the hearth.

576,551. Telephone Transmitter. Marion E. Clark and Earl C. Clark, Minneapolis, Minn. Application filed September 23, 1895.

The diaphragm is made of an electrical insulating material, such as paper or parchment, with a multiple contact device secured directly upon it and provided with a large number of contact points or projections; a disk or button engages the contact points and a binding-piece of material similar to that of which the diaphragm is formed, and whereby the button or disk is secured upon the diaphragm and the multiple contact device.

576,577. Telephone System. Angus S. Hibbard, Chicago, Ill. Application filed May 4, 1896.

This arrangement includes a coin receptacle at the substation, with a conductor branching from the telephone line at the sub-station. Two normally separated contact portions are adapted to be electrically connected through a coin while in the hand of the user, and an indicating device at the exchange is adapted to be included in circuit with the telephone line, branch conductor and coin.



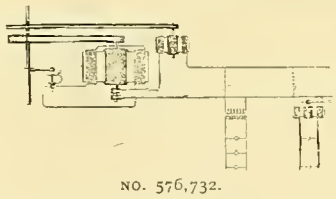
NO. 576,577.

576,621. Electric Switch. Maximilian Schalscha, Hoboken, N. J. Application filed February 20, 1896.

A switch adapted to be carried by a moving device to regulate the current through a motor for the moving device, comprising a switch in the electric circuit, and having a series of contact-plates, a switch-arm for closing the circuit through the plates, a rotary shaft on which the arm is mounted, a rotary shaft having gear connection with the arm-carrying shaft, and arms extended radially from the last-named shaft.

576,622. Electric Locomotive and Railway System Therefor. Maximilian Schalscha, Hoboken, N. J. Application filed February 20, 1896.

This arrangement comprises a car, an electric motor thereon, an electric current conveyor on the track-bed, a trolley having connections with the conveyor, an arm extended from the trolley and having a longitudinal slot, a hanger on the car-truck having a pivot extended through the slot, and a connection between the hanger and the motor.



NO. 576,732.

576,720. Galvanic Battery. Horatio J. Brewer, New York, N. Y. Application filed May 18, 1894.

One claim is for a cover for the cell, a zinc element, an angular connection between the cover and element, a bolt or pin extending upward from the connection through the cover, plates encircling the shank of the bolt, a spring interposed between the plates and holding the zinc in position, a central carbon pencil, loose carbon surrounding the same, a pervious sack for the loose carbon, and drawstrings at each end of the sack.

576,721. Trolley System. Willis G. Caffrey, Reno, Nev. Application filed April 2, 1896.

The composite trolley consisting of the pivoted bars forming an extensible and contractible frame, the centrally located cross guide-rods secured to the trolley pole or cable, and on which the frame slides in adjusting itself, the contact-rollers carried by the frame, and the spring-controlled swinging rollers carried by the frame and acting against the conductors to adjust the frame and hold its contact-rollers to the conductors.

576,732. Electrical Regulating Device. John F. Kelly, Pittsfield, Mass. Application filed July 24, 1893.

An alternating current generator is the source of electrical supply; a circuit is formed for the transmission of the electrical energy developed, and a regulator consisting of an induction motor is connected with the circuit and driven at a speed above that of synchronism.

576,766. Electric Heating Apparatus. Artemas Robertson, Taunton, Mass. Application filed April 5, 1895.

An electric radiator composed of a casing perforated at its bottom and along its upper front portion, a plurality of heating bars, each made up of a wide thin bar of metal, an insulating covering and a heating coil, and supports to hold each bar on a slant upward and inward across the casing, all arranged to cause the air flowing through the lower perforations of the casing to be deflected against the back of the casing and to eddy about the heating bars before escaping through the upper perforations in the front of the casing.

576,802. Electric Arc Lamp. Hermann Cäurlin, Aarburg, Switzerland. Application filed May 11, 1896.

An electro-magnet is included in a shunt circuit of a main armature, having side plates, and a clock-work is supported thereon carrying a ribbon from which the carbon is supported; a horizontal pendulum, a friction disk upon the axis thereof, and an auxiliary armature elastically supported upon the main armature controlled by the electro-magnet, and having an adjustable break-screw to press upon the friction disk, are other features.

576,804. Telephone Apparatus. Charles E. Buell, North Plainfield, N. J. Application filed April 24, 1895.

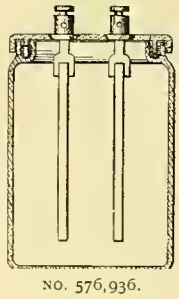
A series of lines radiate from a central station, with an annunciator in each line; connections are made from the several lines to a dynamo; continuity preserving switches for each line are utilized for sending outgoing signals without discharging the annunciator in the line; storage batteries are provided at outlying stations having connections to the lines, and telephone apparatus is connected to the lines.

576,813. Telephone Transmitter. James F. Gilliland, Adrian, Mich. Application filed December 21, 1895.

Saucer-shaped electrodes are provided with a groove about the facing edges; a resilient non-conducting ring is located in the grooves; granular conducting material is confined between the electrodes, and there are opposite axial bearings for supporting the united electrodes.

576,933. Electric Lighting for Vehicles. Jules A. Ageron, Paris, France. Application filed August 2, 1895. Patented in France May 18, 1895.

The automatic circuit-breaker which is a feature of this invention consists of a rotatable hollow body adapted to contain a conducting fluid and constructed of two sections of conducting material insulated from each other.



NO. 576,936.

576,936. Battery. Francis B. Badt, Chicago, Ill. Application filed September 7, 1894.

One claim is reproduced: In a battery cell the combination with a jar of a circular channel at the upper edge thereof, a cover for said jar adapted to support the electrodes, a circular projection upon said cover adapted to rest in said channel, a liquid insulating material in said channel, an opening in said projection, the distance from the surface of the insulating liquid to the opening in the rim being insufficient to prevent the escape of gas under the internal pressure set up by the action of the elements of a Leclanché cell.

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Power Plant of Armour Institute of Technology.

The increased demands for lighting and motor service and additional facilities for laboratory work necessitated a reconstruction of the power and generating plant belonging to the Armour Institute of Technology of Chicago. These demands for new equipment have been met by P. D. Armour in the same generous and progressive spirit which has characterized him in the original equipment of the Institute.

The repairs and additions, now about completed, give to the Institute one of the largest and best power and electrical plants to be found in similar institutions. The main engine is a Hamilton-Corliss single cylinder, 20 by 48 inches, non-condensing, and runs at a speed of 73 revolutions per minute. It is connected by rope transmission to the main countershaft at one end of the engine room. A one-inch Manila rope, cotton core, has been found to give the best results for this drive. On the countershaft are three driving pulleys, fitted with friction clutches. One of these is belted to the line shafting in machinery hall; the other two are belted to dynamos. The larger of these dynamos is a 100 kilowatt direct current six-pole machine, built for 425 revolutions per minute and operated at 115 volts, which furnishes the power for the shops and laboratories and current for both incandescent and arc light. There are nearly 2,000 16 candle power incandescent lamps used in the buildings and laboratories, and a number of constant potential arc lamps. The power service comprises a 20 horse power multipolar motor for operating the machinery of the wood-working shop; a 10 horse power multipolar motor in the laboratory for testing the strength of materials is belted to a line of shafting which runs the Riehle testing machines and pulleys for dynamometer and brake tests; a 30 horse power multipolar motor in the dynamo laboratory operates dynamos under test. In addition there are a number of smaller motors for driving lathes and a ventilating fan. In all about 70 horse power is required for the motor service.

The main countershaft also drives a second dynamo. This is a 45 kilowatt single-phase, compound wound alternator of 60 cycles at a speed of 900 revolutions per minute, and is operated at a pressure of 1,120 volts. This dynamo is used on a part of the incandescent light service and for purposes of laboratory testing. For the lighting service the circuit is led to a bank of transformers which deliver the current to the switchboard at 112 volts; the transformers range in size from 100 to 375 lights. This method was adopted to afford a practical illustration of the alternate current system.

There are two smaller engines in the plant. The one just beside the Corliss is a Russell, single cylinder, non-condensing, with cylinder 11½ by 14 inches, and runs at a speed of 260 revolutions per minute. This engine is of the high-speed, self-contained type. A 50 kilowatt continuous current 115 volt dynamo is belted directly to this engine. This dynamo will be used for lighting the building during the hours of light load. The engine is provided with a second flywheel for brake tests.

The third engine is cross-compounded. Its cylinders are six inches and nine inches by 14 inches, and it is run at a speed of 210 revolutions per minute. It is connected to be used either condensing or non-condensing. It will be employed by the department of mechanical engineering for purposes of testing alone. Just in front of this engine is a Wainwright corrugated tube surface condenser with measuring tanks.

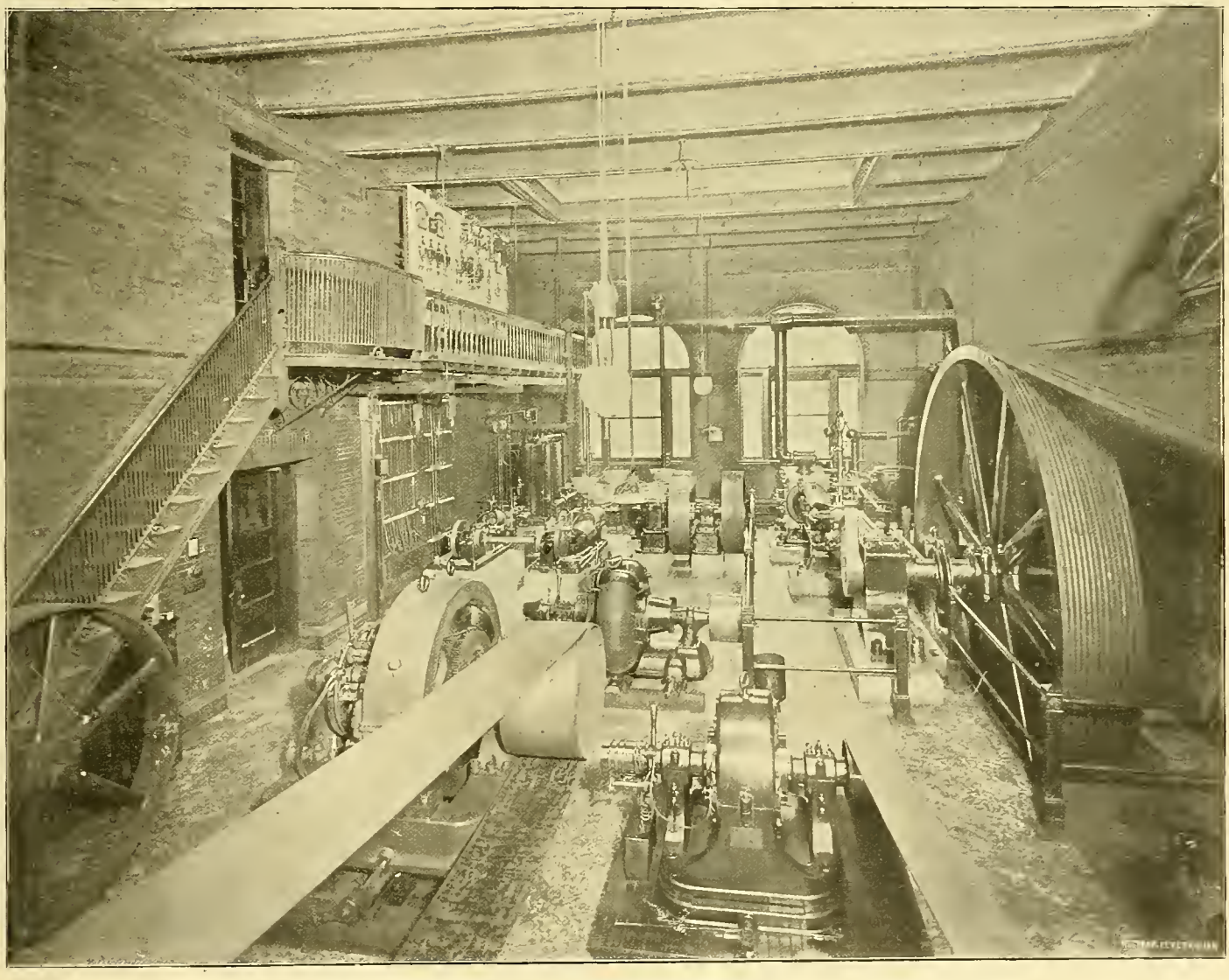


FIG. 1. POWER PLANT OF ARMOUR INSTITUTE OF TECHNOLOGY.—GENERAL VIEW OF ENGINE AND DYNAMO ROOM.

The steam plant contains four 250 horse power Stirling water tube boilers, two of which are fitted with automatic stokers. There is also an ash and coal-conveying system. The boiler plant is used both for heating and power.

The engine room, in keeping with the rest of the building, is a finely furnished one, as the picture on this page, giving a general view, indicates. It is 30 by 60 feet, with a ceiling 25 feet in the clear. The walls are finished with pressed brick and terra cotta ornaments, and the ceiling is in terra cotta. The floor is laid with Tennesseee marble, and all exhaust and drip pipes are run underneath the floor. The leads and field connec-

tions to the dynamos are run under the floor in lead piping laid in cement.

The switchboard is placed on a gallery running along one side of the room. A good view of this part of the room is shown in Fig. 2. The board was designed by the students and built in the shops of the Institute. It contains three panels of white marble, each three by four feet. These are fastened to the usual iron framework. The board stands two feet from the wall and all connections are in plain sight. The center panel carries the main direct current dynamo switches; that on the left the lighting and power circuits, while the right-hand panel is intended to represent an alternating current installation. In addition to the switches, it carries a compensator, a switchboard transformer, with the ammeters and voltmeters for the alternating current. On the left panel are placed a Weston illuminated dial ammeter and a voltmeter of the same type. Below these is a Weston ground detector. The three lighting circuits for the main building are brought to this panel and connected to double-throw switches. The center panel carries two direct-current dynamo switches for the 100 kilowatt and the 50 kilowatt dynamos respectively, and one change-over switch. These are also double-throw. Two of these were built in the electrical shop, one with a capacity of 500 amperes, the other 1,000 amperes. The bus-bars are placed behind the board and are of one inch

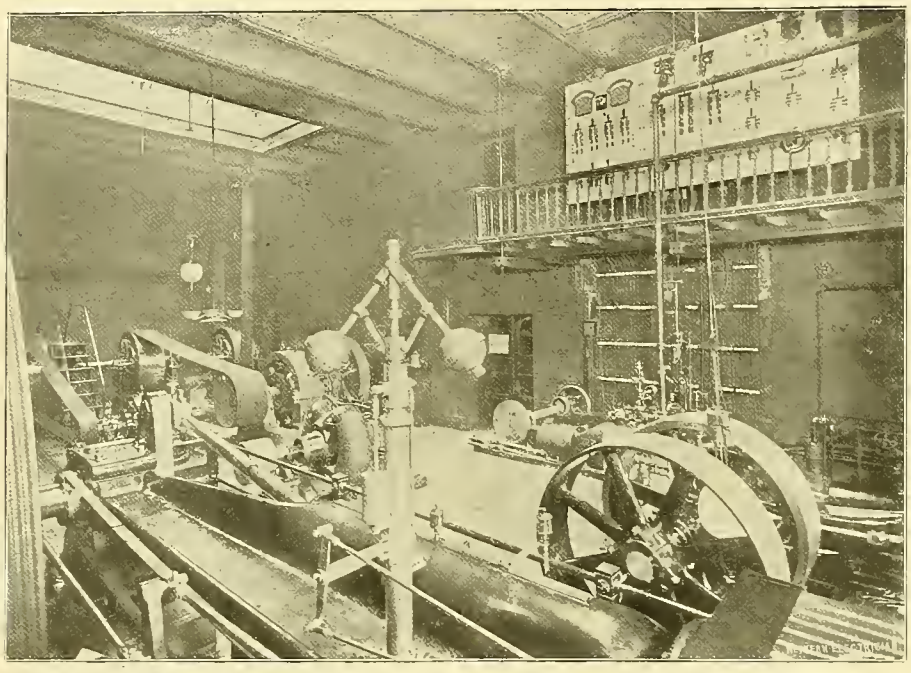


FIG. 2. POWER PLANT OF ARMOUR INSTITUTE OF TECHNOLOGY.—VIEW OF NEW SWITCHBOARD.

round copper. All the connections are heavily taped and those carrying 1,100 volts have been covered with flexible rubber tubing.

The board to do service in such a plant must necessarily be more complicated and flexible in its connections than if it were designed for a commercial plant. Not only must it distribute current for lighting and power, but for a variety of testing purposes. The lighting circuits can be thrown on either of the direct current dynamos or on the alternating current machine. When determining dynamo characteristics it is necessary to drive the motor off a dynamo carrying no other load. The connections to the board are so arranged that the 50 kilowatt dynamo can be operated on this load independently of the others. No provision has been made for operating the dynamos in parallel, since the requirements of the plant do not demand it.

No fuses whatever are placed on the board. The direct current dynamos are protected by I-T-E circuit breakers of 500 and 1,000 amperes capacity.

The alternating current system is of the well-known Westinghouse type. The 50 kilowatt dynamo is of the C & C type, purchased in 1893. The 100 kilowatt dynamo has just been built for the Institute by the Western Electric company.

In the selection of the engines reference was had to variety for purposes of instruction. The Corliss engine was installed in 1892, while the Russell and the compound engines are recent additions. It is hoped that in the near future one or more direct-connected units will be added to the present equipment.

Street Railways and the Illinois Legislature.

Three bills have been introduced by Senator Humphrey in the Legislature of Illinois providing for the regulation of street railways throughout the state. One of these measures seeks to create a commission vested with unusual powers, another provides for the extension of the terms of franchises of existing companies, and the third covers the question of taxation.

The first measure is entitled "An Act to Establish a Commission for Street and Elevated Roads." It creates a commission of three persons to be named by the governor and confirmed by the Senate, which shall have power to regulate the running of cars, the kind of cars to be used and the manner of heating, and to fix the rates of fare. The commission is empowered to determine, when it is proposed to construct any new line, whether it is necessary for the convenience and accommodation of the public, and its certificate that the proposed railroad is necessary is a condition precedent to any city council or board of trustees having authority to grant permission to lay railroad tracks on any street or highway, and in case of an application to construct and operate any new line of road or to extend an existing line, if the commissioners certify that such line is necessary for the convenience and accommodation of the public, the ordinance granting such commission and authority shall run to and be given to the board of commissioners as the grantees therein, and they shall sell the same to the highest bidder in accordance with the provisions of the bill. It also gives the commission power to examine into the condition and management, so far as the same pertains to the relations of such railroads to the public, and to see that the laws of this state relating to the same are complied with and to prosecute all corporations or persons violating such laws.

In all cases where the maximum rate of fare is fixed by ordinance such rate shall not be changed by the commission during the life of the ordinance or any extension thereof.

The second bill, entitled "A Bill for an Act Concerning Street Railroads, and to Repeal a Certain Act Therein Named," is really the most comprehensive in nature and far-reaching its effects of any of the three offered. The vital part of the bill is the extending for 40 years from the first Tuesday in September, 1897, of the ordinances of those corporations having roads in actual operation at that time, provided that when the road is located in a county having a population of 100,000 or over, the corporation operating the same shall pay to the proper officers $2,000 per mile for each mile in length of street or highway occupied. In counties of less than 100,000 inhabitants the payment shall be $500 a mile. Every corporation "already existing" for the operation of street railroads is authorized to take any street, alley, road or highway, or go by tunnel under or by bridge across or over any water or highway, the only condition precedent thereto being the consent of the corporate authorities of a city or village or of the commissioners of highways of towns in counties under township organization. "Existing corporations" are also authorized to condemn private property that may be necessary for the construction, maintenance or operation of their roads, and for use for side-tracks, etc., in the usual manner provided by law. Any grants for the use of streets or any extensions to existing companies may be made for a period of 40 years. All ordinances now in force or that may hereafter be enacted shall be held to be contracts. In the case of ordinances extended for a period of 40 years by this bill, it is expressly stipulated that the overhead trolley may be used as a motive power. No surface road is to have the right to condemn the property or tracks of another road without the consent of such road. All such corporations are given the right to contract with one another for the use of their respective tracks or to purchase from one another if they so choose. The right of such corporations to consolidate is given, the exception being that parallel or competing lines shall not consolidate.

The third bill relates to the taxation of street railway corporations. It provides that any person or corporation operating a street railroad shall pay three per cent. of the gross earnings for the last preceding year in lieu of all taxes to which said corporation on account of its franchise, capital stock or property would otherwise be subject. No other tax except a reasonable license fee for every car operated may be imposed by any city, town or village granting permission for the construction of any street railroad. The sum derived from the three per cent. of the gross earnings shall be paid to the state treasurer, and he is required to pay two-thirds to the corporate authorities of the various towns, cities or villages, in proportion to the number of miles of track operated in each. The remaining third remains with the state. The bill pledges the honor of the state that no other taxation than that therein specified will be attempted on corporations of this nature.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Northwestern Telephone Exchange company was an applicant for a franchise at Waterville, Minn., and had expended about $200 on a line there when the council revoked its rights.

J. H. Van Dyke of Atlantic, Ia., manager of the Iowa Telephone company for several counties, has resigned to accept the management of the Rocky Mountain Bell Telephone company, with headquarters at Wallace, Idaho.

The Des Moines, Ia., City Council has ordered the Bell Telephone company to subsurface its wires in the down-town district, and will probably make similar orders to light, power and telegraph companies.

C. D. Davidson has connected the Western Union offices at Sauk Center, Minn., with his mill and contemplates putting in an exchange for the town.

The Wisconsin Telephone company is preparing for a war at Shawano, Wis., to which place the Northern Wisconsin Telephone company has just completed its wires. The former company is now repairing its system, running double wires and making other improvements, but heretofore the service has been very unsatisfactory.

The Northwestern Telephone Exchange company has connected Albert Lea, Minn., with the Twin Cities by telephone.

P. N. Haycraft contemplates putting in a telephone system at Madelia, Minn.

Des Moines, Ia., now has long-distance connection with Chicago.

The American Telephone & Telegraph company is applying for a franchise at Iowa City, Iowa.

The Mutual Telephone company of Des Moines, Iowa has let the contract to furnish 1,200 poles and will begin setting them as soon as the frost is out of the ground.

The Wausau (Wis.) Telephone company will reduce its rates May 1st to $2.50 for a business connection and 75 cents for a residence.

W. H. H. Cash will soon build a telephone line from Mauston, Wis., to New Lisbon.

A. T. Presson of Fowler, Ind., has been granted a franchise for a telephone exchange at Hudson, Wis.

Six sick patrons of the Marshalltown Telephone company heard the opera "Wang" at Marshalltown, Iowa, over the wires of the company.

The Barron County Telephone company held its annual meeting at Barron, Wis., last week, and the directors are highly pleased with the results after but six

months of actual operation. The system will be extended to Chetek, Dallas, and Prairie Farm in the spring.

T. B. Catlin succeeds Mr. Hillhouse as representative of the Michigan Bell Telephone company at Iron Mountain, Mich. The company is improving and extending its system in that territory. This company has offered free telephone service at Escanaba, Mich., to freeze out the exchange now in operation, owned by George Finch, which is alleged by its partisans to be giving better service than the Bell company ever did.

Accumulators in French Telegraphy.

Previous to 1892 the central telegraph station of Paris required for its electrical elements no less than 10,000 Callaud cells of the larger type. The adaptation of the accumulator system for telegraph purposes and the constantly increasing demand for room, as more battery was required for the constant growth of the enterprise, has, within the last five years, resulted in displacing the Callaud elements and substituting accumulators.

The central telegraph station accumulator installation comprises two distinct batteries, the Laurent-Cély of 50 elements, with a capacity of 60 ampere-hours, and the Tudor of 60 elements, with a capacity of 72 ampere-hours. The weight of the former plates is five kilogrammes the latter 15 kilogrammes.

The first is for the night service, which of course is comparatively light, while the heavier day service is dependent on the heavier battery. The Tudor battery supplies the current equivalent of 533 line batteries and 87 locals, and in addition runs five motors for Baudot distributers. This battery, being used during the day, is charged during the resting hours between 10 P. M. and 6:30 A. M., while the smaller battery is on duty.

The 60 elements are placed upon two strong trestles arranged in parallel—in rows of 15 cells each, as shown in Fig. 1, plan and profile. All connections are thoroughly soldered, both in the battery and line contacts. The elements are supported on special insulators of porcelain, *i*, filled with heavy oil.

The battery is tapped at various points according to

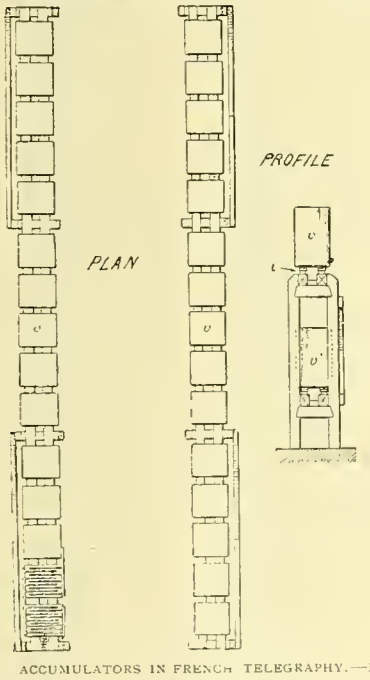


FIG. 1. ACCUMULATORS IN FRENCH TELEGRAPHY.—PLAN AND PROFILE OF BATTERY ARRANGEMENT.

the needs of the lines to be supplied, these being in parallel and all headed in one direction. This system entails the objection, however, of working the cells hardest which are nearest the commencement of the combination, unless, as in this installation, some measure is introduced to equalize the drain.

Careful precautions have been adopted to guard against accident which might suddenly discharge a heavy current with possible serious results, either through short-circuiting or grounding the battery. There is placed in each group a series of resistances, one for each instrument, which, in case of a current superior to one ampere, will fuse and open the line. This is shown in Fig. 2, in plan and section. An insulation of wood carries two binding screws, between which the fuse wire is seen. As there is one of these safeguards for each instrument, any local accident upon that branch will only affect that one line, and when the difficulty is removed the fuse can readily be renewed. Independently of and in addition to this, each line is similarly protected, and the common ground wire of each group has also a fuse. Fig. 3 shows the arrangement of the distribution, with the accessories.

As the dynamos which charge the accumulators furnish a current with only 70 volts potential difference and a battery of 60 accumulators requires in charging about 150 volts, the elements are grouped into three batteries of 20 elements each and charged in parallel. In discharging, the entire three groups are arranged in series. This change is effected readily and perfectly by the commutator shown in Figs. 4 and 5 in detail. Each

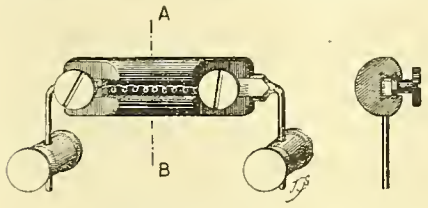


FIG. 2. ACCUMULATORS IN FRENCH TELEGRAPHY.—CUT-OUT FUSE CONNECTIONS.

battery is similarly arranged, and the combination is seen in Fig. 3 at *C* and *C1*.

The action of the commutator is quite simple. A single movement of the handle *M* (Figs. 4 and 5) arranges the battery in series of 60, or in three groups of 20 in parallel. There is a cylinder of insulating material *C*, capable of rotary motion on its longitudinal axis; metallic plates are embedded in its surface *l l*, capable of contact with two series of springs, *r r1*, which press on the cylinder.

In Fig. 4 these contacts are in the position for charging the battery. The positive pole of the dynamo is connected to the three springs $+D$, and its negative terminal to those marked $-D$. The negative pole of the accumulator No. 1 is in contact with the spring $1-A$; the positive pole of the twentieth ends at the spring marked $20+A$. If we consider this section of the battery we shall see that the spring $+D$ is directly connected to the spring $20+A$ by the plate *l 2*, and the spring $-D$ to the spring $1-A$ by the plate *l 1*. The same condition exists with the other two sections, and the charging is thus effected simultaneously in the three groups of 20 elements. In this position the springs placed at the right are not in contact; they are completely isolated from the battery.

In Fig. 5 these last are in contact, and the reverse is true of the contacts which have just been described. The entire series of elements is now in tension and in a position of discharge.

The line contacts are made at the points $a+3$, $a+5$, $a+8$, etc.; through the plates on the cylinder these contacts are continued to the plates the strips marked 6, 10, 16 volts, etc., and from thence current is led to various lines. A movement then of the handle *M* to the right or left places the battery at once in position for discharge or charge.

The entire installation is represented in Fig. 6.

During the charging the dynamo current flows from the positive brush to the cut-out $D+$ on the table of distribution or switchboard. Thence the current, having passed through the ammeter *A*, which shows the output of the generator, goes to the regulator *R* and to the terminal *b*, where there are three derivations, *1*, *2*, *3*. Tracing derivation *1*, the current follows the lines thus: Rheostat *R'*, ammeter *A'*, commutator C_2, terminal *1*, positive pole of the accummulator *1* of the first group of the Laurent-Cély negative pole of the twentieth element, terminal *1*, commutator C_2, terminal b_1, cut-out $D-$ and negative terminal of the dynamo *D*. Similar lines trace the course of the current from the point of derivations *2* and *3*.

For charging the Tudor battery the handle *M* is turned 90 degrees into the position of discharge, as shown in Fig. 5, when the connections will be in the proper form for the charging of the second battery.

An automatic cut-out breaks the circuit whenever the electromotive force of the dynamo becomes inferior to that of the accumulators through any mischance or lack of speed, casting of the belt or other cause. An examination of Fig. 6 will show the route of current in service during discharge

All communication is now cut off from the dynamo. The current, for instance, from the third element of the first group of the Tudor battery flows to the terminal *6* on the right of the cut, from thereafter passing the commutator *C'*, which connects the two springs, it goes to the terminal *6* at the top of the figure to the two terminals *6* of the battery board, and finally to the distribution bus-bar of the central office.

The battery board shown at the lower part of Fig. 6, on the right, embraces proper switches for three contacts: *A*, accumulator current, *P*, a contact with primary batteries if accident requires, and a dead point between the two. The negative pole of the Tudor battery is grounded through the commutator C^1, and the wire running to *T*.

The connection of the other sections of the battery are similar to that given.

The dynamo room or battery room board comprises all the accessories necessary for testing current, voltage, etc., variously connected at will to a second board, shown at Fig. 7, which is a more complete elaboration of the lower right half of Fig. 6, and shows the various switches with contacts, etc. The lower portion of this board has on the left the necessary contacts for primary batteries when occasion requires, the right having similar contacts for the accumulators.

Forty switches permit of all necessary contacts between the current-carrying devices and the lines, and an equal number of fusible cut-outs of four amperes, *c*, *c*, etc., protect the system, while a voltmeter to which a flexible cord is attached tests the electromotive force of batteries or accumulators at will. As a further precautionary measure a series of annunciators *a*, *a*, *a*, *a*, is set to ring with an excess of current flow.

The entire system, though somewhat complicated, has throughout worked thoroughly satisfactorily, perfectly and constantly as well. The facts are taken from *L'Electrician*.

Municipal Ownership Voted Down in Charlotte, Mich.

In the latter part of January the City Council of the city of Charlotte, Mich., called an election to take place

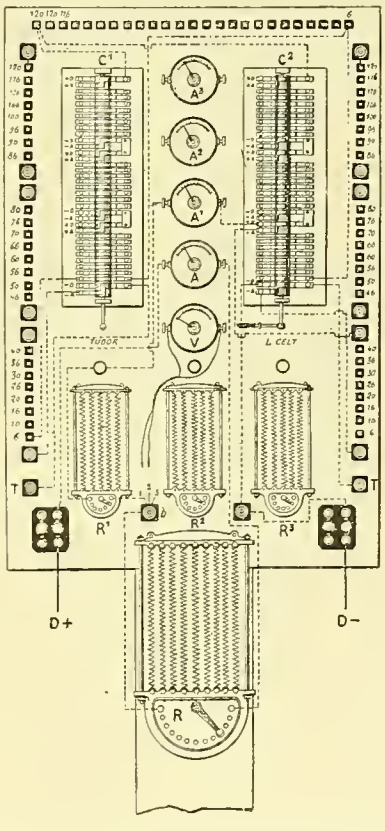


FIG. 3. ACCUMULATORS IN FRENCH TELEGRAGHY.—ARRANGEMENTS FOR DAY AND NIGHT SYSTEMS OF CONTACT.

on February 1st, for the taxpayers and voters to decide whether the city should own its own lighting plant, to be operated in connection with the city water works. A public meeting was called by the mayor on Thursday, January 28th, and Frank B. Rae of Chicago and Mr. Humphreys of Detroit were on hand to address the citizens and taxpayers. On that day W. P. Engle, the central station manager, telegraphed to W. Worth Bean of St. Joseph, Mich., to come to Charlotte and assist him in opposing the plan of municipal ownership. At the meeting, from 8 P. M. until 11:30 P. M., the audience listened to arguments for and against municipal ownership. On the following Monday the election took place, and 457 votes were cast against municipal ownership and 53 for it. It is evident that Mr. Bean did some good in his arguments against municipal ownership, from the way the votes were cast.

The Telephone Situation.[1]

By W. Clyde Jones.

It is the purpose of the present paper to present a brief outline of the journey by which the telephone and the telephone industry have arrived at the present stage; secondly, to view the present situation, and lastly to consider if perchance present conditions may point the possible path of travel which the industry is destined to pursue.

Again, as was the case 10 years ago, the legal battle centers around the means for transmitting the speech, and the future journey of the art will in great measure depend upon the view the courts may take of the transmitter situation. The controversy at present wages over the Berliner patent, which is claimed to cover all forms of variable pressure transmitters. For 17 years the assignees of Alexander Graham Bell have enjoyed under the fundamental telephone patent the monopoly contemplated by the government as a compensation to the inventor for the fruit of his brain. The conditions have been ideal, and the intent of the patent laws has been admirably fulfilled, as not only the inventor, but also his assignees, who have furnished the capital to develop the invention, have been handsomely rewarded from a pecuniary standpoint, while the inventor has received the plaudits of an admiring and grateful world.

But at a time when the compensating period of monopoly is about to expire and open to the public the privilege for which it has given ample consideration, the public has been cruelly disappointed by the announcement that a patent has been granted to the owners of the original patent upon a minor feature of construction which practically gives new life to the telephone monopoly during the further period of a patent. And we are informed that this prolongation of the monopoly has arisen through the cumbersomeness of our own governmental machinery. Is it to be wondered that certain populistic members of our Congress, seeing but one of the errors, and not appreciating the many merits of our patent system, persist in tacking to congressional bills of all descriptions, in hidden and unexpected clauses, riders which would, if not detected, rob us of our admirable patent system? Would it not be an act of magnanimity should the owners of this patent voluntarily relinquish the undue advantage which an unintentional operation of defective patent laws has given them, and thus remove one of the greatest menaces to our patent system? When one recalls the severe shock and almost utter annihilation of our patent system which the rigid enforcement of the monopoly secured by the grant of the driven well patent entailed, it must be appreciated that our patent system is a plant of tender growth and by no means the hardy shrub which some might consider it.

To understand the present situation, it will be necessary to consider briefly the evolution of the telephone transmitter. In 1854, Charles Bourseul said: "I have asked myself if the spoken word itself could not be transmitted by electricity; in a word, if what was spoken in Vienna may not be heard in Paris. The thing is practicable in this way. * * * Suppose that a man speaks near a movable disk sufficiently flexible to lose none of the vibrations of the voice; that this disk alternately makes and breaks the connection with a battery; you may have at a distance another disk which will simultaneously execute the same vibrations."

Bourseul thus stated a proposition which Philip Reis sought to solve, but he followed Bourseul's suggestion too closely to realize the transmission of speech, though he successfully transmitted musical sounds. He employed as a transmitter a diaphragm which in its vibration opened and closed an electric circuit, thus sending impulses over the line to a receiver comprising an electromagnet opposite the pole of which vibrated an armature mounted upon a pivoted plate which in beating the air reproduced the sound. Since his transmitter opened the circuit in vibrating, Reis was unable to transmit speech.

Bell conceived as a mathematical proposition that in order to transmit speech the circuit must not be broken to send impulses over the line, but that the current must be caused to undulate in exact accordance with the undulations to and fro of the air particles in constituting the sound. His mathematical theory was proven to be correct, and the speaking telephone was an established fact. A patent was granted to Bell broadly covering the method of transmitting speech by an undulatory current, March 7, 1876, No. 174,465. Bell described in his patent a number of ways of producing the undulatory current. He says:

> Undulations are caused in a continuous voltaic current by the vibration or motion of bodies capable of inductive action; or by the vibration of the conducting wire itself, in the neighborhood of such bodies. Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. The internal resistance of the battery is diminished by bringing the voltaic elements nearer together, and increased by placing them further apart. The reciprocal vibrations of the elements of a battery, therefore, occasions an undulatory action in the voltaic current. The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence, the vibration of the conducting wire in mercury or other liquid included in the circuit occasions undulations in the current. The vertical vibrations of the elements of a battery in the liquid in which they are immersed, produced an undulatory action in the current by alternately increasing and diminishing the power of the battery.

Elisha Gray, who independently discovered the requisite undulatory current necessary for the transmission of speech, employed a vessel containing acidulated water into which dipped a needle carried on the diaphragm, the needle and the liquid being included in the circuit and the variable immersion of the needle due to the vibration of the diaphragm causing avariation of the resistance of the circuit by varying the surface of the needle in contact with the liquid. Bell in practicing his invention had employed a vessel containing mercury into which dipped a cone-shaped electrode vibrated by the diaphragm varying the extent of the surface of the cone in contact with the mercury and thus varying the resistance of the circuit in which were included the cone and the body of mercury. The variation of resistance was thus due to the variation of the surface of contact between two electrodes, one of which was solid and the other liquid.

It was at this stage of the art that Berliner appeared and in a caveat filed in the Patent Office, April 14, 1877, showed a telephone in which two solid electrodes were employed in constant contact. One of the electrodes was vibrated by the diaphragm to vary the surface of contact between the two electrodes. Subsequently to the filing of the caveat, on June 4, 1877, Berliner filed an application for a patent on a telephone in which a diaphragm forming one terminal of the circuit was adapted to vibrate between two contacts, one situated upon the front and the other upon the rear of the diaphragm, the contacts being connected with the opposite terminal of the circuit. The fact that Berliner thus filed an application on a make-and-break telephone incapable of transmitting speech, after having shown in his caveat a constant contact transmitter, is alleged to show that he had not received successful results in the operation of the transmitter of the caveat and had abandoned it for the double contact transmitter. The application was afterward amended to show and claim the constant contact feature, and upon this application the Berliner patent of October 29, 1891, was granted.

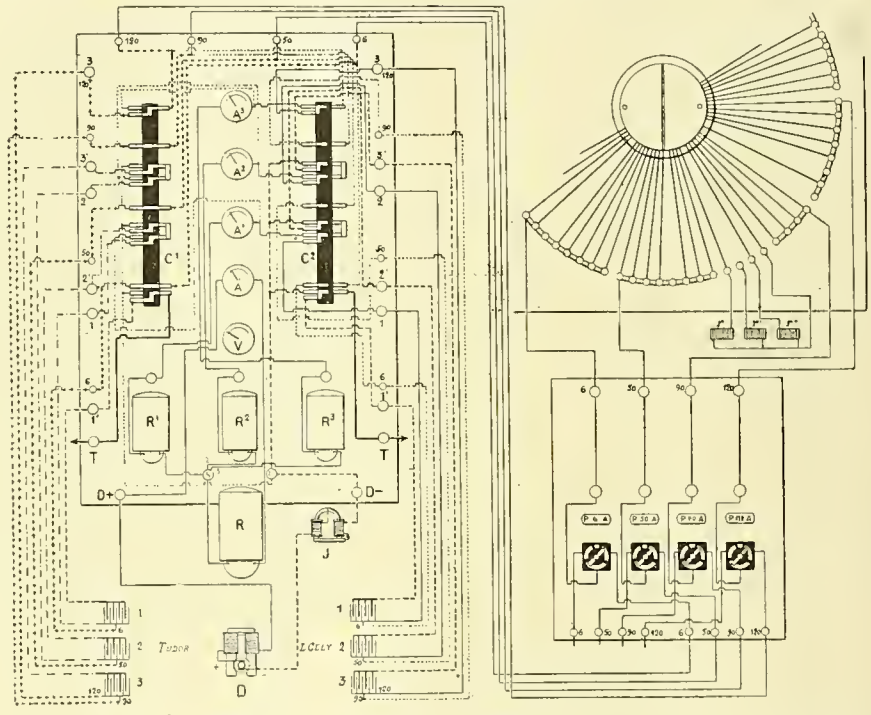


FIG. 6. ACCUMULATORS IN FRENCH TELEGRAPHY.—PLAN OF DISTRIBUTION.

About the time of the Berliner experiments, Edison was developing his carbon transmitter, and subsequently to the filing of the Berliner application a description of his invention was published on July 9, 1877, in the *Philadelphia Press*, and as it was after this, on August 8, 1877, that the amendment was made to the Berliner application erasing the double-contact feature and substituting the constant-contact feature, it is claimed that the amendment was made to embody Edison's invention, and this is one of the grounds on which the patent was attacked. The Patent Office, however, held that Berliner was entitled to the idea of two electrodes in constant contact, while Edison was awarded broadly the feature of employing carbon as an electrode. Edison's patents on this feature were granted in 1892, but as foreign patents had previously expired and as United States patents previously patented in a foreign country expire with the first expiring foreign patent, the Edison patents had technically expired before they were granted, if such an anomalous state of existence can be imagined.

Subsequently a patent was granted to Hunnings for a telephone in which granular carbon was employed. This patent has already expired with a foreign patent for the same invention.

Thus, the only controlling patent on the transmitter which has not expired is the Berliner patent, the claims of which are as follows, and on their face cover all forms of variable pressure transmitters:

> 1. The method of producing in a circuit electrical undulations similar in form to sound waves, by causing the sound waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and decrease the resistance of the circuit, substantially as described.
> 2. An electric speaking telephone transmitter operated by sound waves and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other and forming a part of a circuit which includes a battery or other source of electric energy, and adapted to increase or decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

By reference to the quotation from the Bell patent it will be observed that means are described for producing an undulatory current by varying the electromotive force, and means are also described for varying the resistance of the circuit; the internal resistance of a battery by raising and lowering the plates or by moving them toward and from each other, and the external resistance by varying the resistance between electrodes in constant contact. As employed by Bell and by Gray, one of the electrodes had been solid and the other liquid, the variable pressure produced by the diaphragm resulting in varying the surface contact of the electrodes and also varying the length of the path through the liquid. The cone electrode of Bell operated solely upon the variation of the surface contact between the solid electrode and the mercury electrode.

The step which Berliner took was to replace the mercury electrode of Bell by a solid electrode. In this case as in that of Bell's transmitter, the variable pressure produced by the vibration of the diaphragm varied the extent of the surfaces of the two electrodes in contact, and thereby varied the resistance, the greater the movement of the diaphragm, the greater being the size of the surface of contact. Edison and Hunnings also employed solid electrodes, Edison employing a carbon electrode in contact with a second electrode of carbon, platinum or other material, while Hunnings employed a plurality of electrodes of carbon in the form of small granules, the extent of the contact surfaces between which was varied by the vibration of the diaphragm.

The following is a tabulation of the different ways in which it had been proposed to produce undulatory currents at this time:

1. By varying the the electromotive force,
   - (a) By magnetic induction.
2. By varying the resistance.
   - (a) By varying the internal resistances.
     - (1) Distance between plates.
     - (2) Area of plates.
   - (b) By varying external resistance.
     - (1) One liquid and one solid electrode.
       - (a) Amount of liquid in circuit.
       - (b) Amount of surface of electrodes in contact.
     - (2) Two solid electrodes.
       - (a) Amount of surface of electrodes in contact.

It will be observed that all of these different ways of producing the undulatory current were suggested by Bell in his patent except the last, that of varying the amount of surface of solid electrodes in contact,

The Berlioer application was in the Patent Office 14 years, and this long delay, together with the fact that the controlling claims granted at a time when the original Bell patent was about to expire, were founded upon an invention made but shortly after Bell's invention, and the fact that this second controlling patent would practically double the telephone monopoly, led to the institution of a suit by the government to annul the patent on the ground that the applicant and his assignee, the American Bell Telephone company, had been guilty of fraud or misconduct in delaying the issuance of the patent, and on the ground that the commissioner of patents had exceeded his powers in the granting of the patent. At the hearing other objections to the validity of the patent were raised, but the Court of Appeals held that these could properly come before the court only in an infringement suit, and not in a suit by the government to annul the patent for irregularity in the method

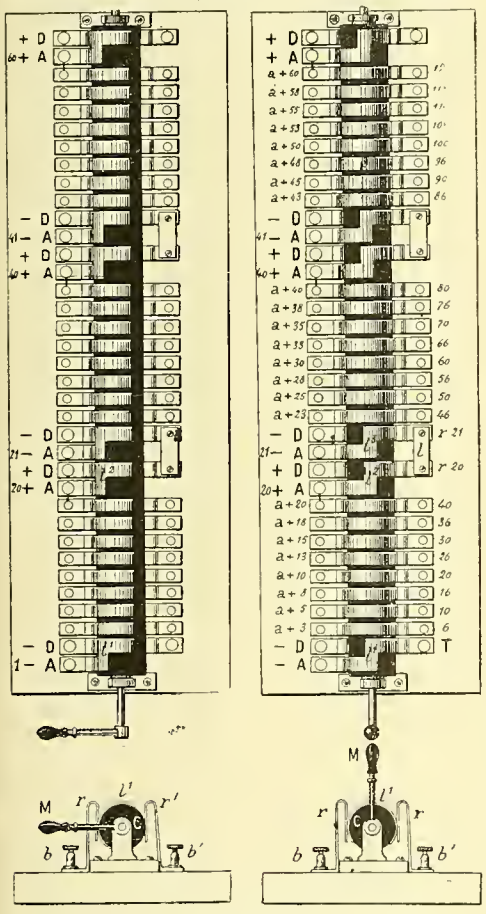
1. Read before the Chicago Electrical association, February 5, 1897.

of granting the patent. The Court of Appeals held that the facts attending the delay were not such as would lay either fraud or misconduct at the door of the patentee or his assignees, since the delay had been occasioned by the rules and procedure of the Patent Office, and the court held that the commissioner of patents had acted within his powers in granting the patent. The case was appealed and has been argued before the Supreme Court. Should this court find the patent to be irregular, the controversy will be at an end. If the Supreme Court, however, follows the decision of the Court of Appeals it will declare the grant of the patent regular, and then when an infringement suit is instituted all the objections to the patent which are claimed to invalidate it, outside of the question of irregularity in the grant, will be considered. Should the Supreme Court, however, choose to consider all of the objections urged against the patent, its decision will terminate the controversy.

It may be interesting to consider what are some of the defenses to the validity of the patent which would thus arise in an infriogment suit.

One of the defenses is that the constant-contact feature was not present in the Berliner application as originally filed, the application showing only the make-and-break double-contact transmitter above referred to, and that the constant-contact feature was interpolated into the case only after the publication of Edison's constant-contact carbon telephone. If this can be proven it will of course invalidiate the Berliner patent.

Another defense is that the first claim of the Berliner patent purporting to cover the method of producing an undulatory current by varying the pressure between two electrodes in constant-contact does not define a method within the contemplation of the patent laws. It has been held that a patentee is not only entitled to a patent on the mechanism he may use for practicing his invention, but if an action or change of a chemical or elemental nature takes place he is also entitled to a claim for the method. To be a proper and legal method claim, it must occupy a somewhat difficultly defined position between two extremes; it must not be a claim for a principle or law of nature, and it must not be for the mere function or operation of a machine or mechanism. For instance, had Henry or Faraday upon the discovery of the law of magnetic induction claimed the method of inducing an electric conductor in a circuit which consists in varying the magnetic field to which the circuit is subjected, the claim would have undoubtedly been held void as claiming a principle or law of nature, since



FIGS. 4 AND 5. ACCUMULATORS IN FRENCH TELEGRAPHY.—THROW-OFF SWITCH FOR CHARGING AND DISCHARGING.

the claim is but the statement of the law of induction, which is as absolute and independent in its invariable action as the law of gravitation, which always acts in one unchangeable manner regardless of human interference. Human agency may control the time of its action, but not the nature of its action.

On the other hand, the method, for instance, of producing a variable flow through a water pipe which consists in continuously varying the port or opening in a valve would not be a proper method claim, since it describes merely the mode of operation of a valve, that is, the function of a mechanism. Likewise, the description of the operation of any particular mechanism for varying the flow of a current along an electrical conductor would seem to be the description of the mode of operation of the mechanism merely and not a proper method claim. As an illustration of a proper method claim lying between this Scylla of a principle or law of nature and this Charybdis of a mode of operation of a mechanism, may be cited the method claim of the original Bell patent, which is as follows:

5. The method and apparatus for transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth.

This claim has been held by the Supreme Court to be a proper method claim. It does not define a law of nature because human agency must intervene to make the laws of force and the law of induction co-operate and act in a particular manner different from that in which they would act were they left to act uncontrolled. In other words, human agency is an element of the process, and thus the process is not a law of nature. On the other hand, the method is not the description of the mode of operation of a mechanism, since it can be contemplated independently of any mechanism. It is one of the tests of a legal process that it can be entertained by the mind independent of any material agency or mechanism for effecting it.

We have seen, however, that undulatory currents can be produced, first, by varying the electromotive force of a current, and second, by varying the resistance which the current encounters. It will be noted that the method of producing an undulatory current is a method

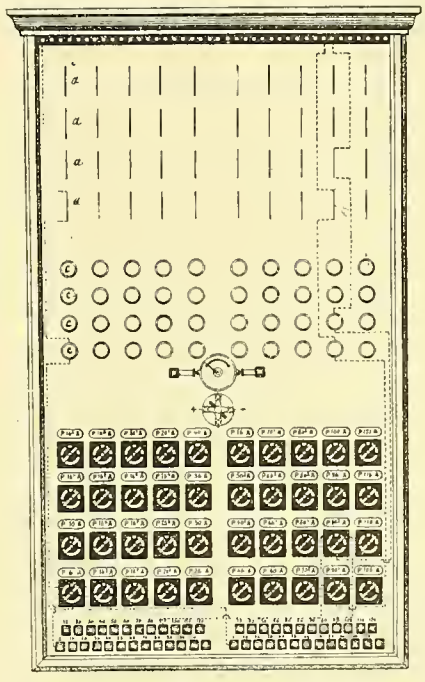


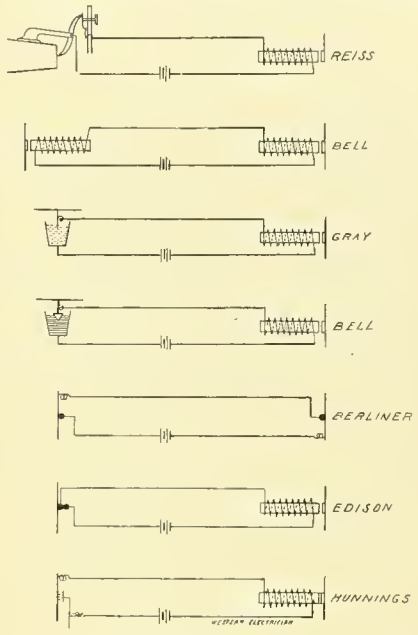
FIG. 7. ACCUMULATORS IN FRENCH TELEGRAPHY.—DETAILS OF SWITCHBOARD.

which does not define a principle or law of nature, nor does it define the mere operation of a mechanism, since we can contemplate the varying of the electromotive force of a current independently of any specific mechanism for effecting such variation. Likewise, the method of producing an undulatory current which consists in varying the resistance to which the current is subjected would seem to define a proper method. Both of these methods are the invention of Bell and were disclosed in his patent, so that he alone of the telephone inventors was entitled to make these claims.

Had Bell drawn a claim to cover the method of producing an undulatory current by moving a mass of magnetic metal toward and from the pole of an electromagnet, it would seem that the claim would not have been a proper method claim, since it defines the mere operation of a piece of mechanism, the only proper method claim capable of being drawn upon this operation being that for varying the electromotive force. On the same grounds it is contended that the method claim of the Berliner patent which is drawn to the method of producing undulations by varying the pressure between electrodes in constant contact to vary the resistance, is but a description of the operation of a mechanism, the only proper method which can be drawn to the invention being that relating to the varying of the resistance; but this Berliner was not entitled to make, as it was disclosed by Bell in his liquid transmitter.

It is further argued that even though the claim be admitted to a proper method claim, it defines the method of Bell's electrode transmitter, which shows means for varying the resistance by varying the surface contact between two electrodes, which is the operation of the Berliner electrodes.

It is also argued that the second claim of the Berliner patent defining the mechanism defines the structure of the Bell electrode transmitter which also varies the resistance by the variation in pressure between the electrodes, causing, as in the Berliner transmitter, a variation of the surface contact between the two electrodes. It is also pointed out that the use of two solid electrodes is not new with Berliner, these having been employed by Reis, whose mechanical construction was the same as that of Berliner. In the use of his transmitter, however, Reis did not maintain the electrodes in constant coatact, though without changing the construction, and by the adjustment of a spring the Reis electrodes may be maintained in constant contact and will transmit speech. It is contended that the novelty in the solid-electrode constant-contact resides in the use of Reis' transmitter in accordance with the method of undulations invented by Bell. Bell used a constant-contact



THE TELEPHONE SITUATION.

transmitter having one liquid electrode, and the probability is that prior to Edison's discovery of the yielding nature of carbon under pressure, speech had not been satisfactorily transmitted by solid electrodes in constant contact.

Another ground for the invalidity of the patent is that a patent was granted to Berliner November 2, 1880, No. 233,969, which is alleged to cover the same invention. After his experiments with the microphone transmitter Berliner found that if an undulatory current be passed through two electrodes in constant contact, the electrodes will become charged as the current rises and the electrodes will repel each other; as the current decreases the charges decrease and the electrodes move together, due to the resiliency of the diaphragm. The device thus acts as a telephone receiver. The mechanical construction of the receiver is identical with that of the transmitter, and the device can be used either as a transmitter or as a receiver, accordingly as it is spoken into, or as an undulatory current is passed through the electrodes. This fact led Berliner to associate two of the instruments at opposite ends of a telephone line, so that conversation could be carried on with the two instruments, the instrument at one end of the line being used as a transmitter while that at the other was being used as a receiver to transmit speech in one direction; and when it was desired to transmit speech in the opposite direction the instrument formerly used as a transmitter was used as a receiver, and the instrument first used as a receiver was now used as a transmitter. Each of the instruments thus served in turn as a transmitter and as a receiver. Claim 4 of this patent is as follows:

4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with another, either or both poles of each instrument being connected with a vibratory plate, so that any vibration which is made at one contact is reproduced at the other, substantially as described.

This claim is not drawn to the receiver alone as are the other claims of this patent, nor to the transmitter alone as are the claims of the 1891 patent, but to an association of two instruments, each capable of two uses, first, as a transmitter, and second, as a receiver. In other words this claim covers an apparatus having two functions, first, the transmission of speech, and second, the reproduction of speech.

The Supreme Court has held (Miller vs. Eagle Manufacturing company, 151 U. S., 186) that where a patent has been granted upon a certain structure having two functions or modes of operation, a subsequent patent upon the same structure, but claiming but one of the functions, is invalid. The invention related to a peculiarly shaped spring which acted upon a plow beam when at a certain height to press the same into the ground, while, when the beam was at a greater elevation, the spring served to support the beam in an elevated position. The earlier patent claimed the spring of the peculiar shape having the function of lifting the plow beam and also the function of depressing the plow beam, while the later patent claimed the same peculiarly shaped spring having the lifting function alone. It is argued that the earlier Berliner patent claims the electrode transmitter having the function of transmitting and of receiving speech, while the later patent of 1891 claims precisely the same structure having the one function of transmitting speech. It is claimed that the Berliner patents bear exactly the same relation to each

[*Continued on page 124.*]

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IF the meeting of electrical men at the Union League Club in Chicago last week accomplished nothing more than to bring them together in social intercourse once more, it would have fulfilled a good purpose, but it did more. It demonstrated that there was a better feeling among those in position to judge the present condition of business and the outlook for trade. Admittedly there is noticeable improvement; there has been a change in the right direction. Conservative men do not anticipate a boom, but they look for a gradual and natural increase in trade corresponding to the revival in other lines. While it is true, as stated by one speaker at the banquet, that the electrical business is comparatively a new industry and had not the accumulated profits of years to fall back upon when the hard times came, as was the case in other lines of trade, it is also a fact that it has the advantage of a comparatively undeveloped field to offer as inducement for those who are in position to take advantage of the situation, and that the public at large is only just awakening to a realization of the many uses to which electric current can be put. After the struggle of the last three years it was really a positive relief to note the hopefulness and renewed confidence of those who participated in last week's symposium.

NO BETTER indication of the tendency of the times can be desired than the expression of unqualified approval on the part of the New York, New Haven & Hartford Railroad company, through its president, of the practicability and advantages of electric motors as a substitute for steam locomotives. Mr. Clark's recital last week before the legislative committee on railroads at Hartford of the experience of the Consolidated company confirms all that has been said in this journal about the experiments that have been conducted upon that system. It appears that the actual results obtained were far more satisfactory than the company had reason to expect from the representations of the electrical engineers who were consulted upon the subject. The experiments determined that higher speed could be attained with electric motors than with steam locomotives, that electricity was capable of doing satisfactory work where the requirements were exceptionally exacting, that it was far more economical and that it was thoroughly reliable. The management realizes that the time has arrived when steam railroad companies must take up this problem seriously and make use of this factor in modern railroading. President Clark says: "Our locomotives may go into the scrap heap, as the old stage coaches had to go. We must keep up with the times or else we shall be left in the rear."

MAGNANIMITY is not a characteristic feature of the policy of the American Bell Telephone company. That corporation has been conducted upon strict business principles throughout its career, and we cannot at this time recall anything in its history that would indicate that the management was influenced by sentiment or generous impulse. The saying that it is hard to teach an old dog new tricks applies to this situation. The company will not relinquish any advantage that it may possess in the ownership of the Berliner patent, and in spite of the conditions and circumstances mentioned by Mr. Jones in his paper on "The Telephone Situation," there is not the remotest possibility of the company pursuing any other policy than that which it has followed since its formation.

In spite of these facts it may not be amiss to consider whether the management of the American Bell Telephone company or any other corporation similarly situated would be justified in pursuing any other course even though it might be disposed to do so. In the first place the responsibility of adopting such a policy without the unanimous approval of the stockholders would involve a grave legal question. Then, too, the rights of companies operating under licenses from the parent company would have to be considered. There can be no question that much of the capital invested by residents of the localities in which local exchanges are operated was attracted because of the supposed impregnable position of the parent company on the question of patents. Would the parent company be justified in relinquishing any advantage that might affect the value of these local securities?

Considered as a broad question of public policy there can be but one opinion, and that is that the American Bell Telephone company has already enjoyed all the protection under the patent laws that it is justly entitled to or that the spirit of our institutions intended that they should confer, but the letter of the law is such that it may extend the term of these privileges still longer, and if this be true no one can reasonably expect other than the most exacting demands of the corporation thus favored.

THREE bills were introduced in the Legislature of Illinois last week providing for the regulation of the street railway companies of the state, which have attracted a great deal of attention and provoked much adverse criticism, yet they are the natural result of the conditions that prevail throughout the state, especially in the larger cities.

One of these measures authorizes the creation of a state board of railroad commissioners, and defines the powers and duties of that body. In some respects it resembles the act under which a similar body was created in New York several years ago, which, it must be confessed, has not proved entirely satisfactory to the people or the corporations, and yet has done much to merit approval. The second bill proposes the extension, for a period of 40 years, of ordinances under which established street railway companies are now operating subject to certain regulations and restrictions. The last measure imposes a three per cent. tax upon the gross receipts of all street railway properties in lieu of other taxes to which the corporations would be otherwise subject, excepting a reasonable license fee for each car operated, which shall be determined by the local government.

The chief objections to these bills are the unusual powers conferred upon the commission, which it is admitted will effectually enable it to prohibit competition where it sees fit, and the extension of existing franchises, which will dispose of the movement for reduced street railway fares. No doubt these features commend the proposed bills to the favor of the street railway companies, as they would afford a simple solution of the grave problems now confronting them. It is admitted that one of the greatest menaces to the value of street railway properties at this time is the danger that is constantly confronting the companies of having franchises granted corporations that are formed merely for the purpose of being bought out. Another movement that has had a tendency to shake the faith of investors in street railway securities is the agitation for reduced fares. It must be acknowledged even by those who favor such a scheme that the plan of reducing the price of transportation on surface roads 20 to 40 per cent. is a serious problem, and that the claim that such a policy will correspondingly increase the number of passengers and thus recompense the company is based largely on conjecture.

REPORTS from every part of the country indicate that the action of the Northwestern Electrical association upon the subject of "Municipal Ownership" has attracted more attention than is usually given the views of organizations of this character upon such questions. It is evident from the tone and character of the present discussion that while the subject is one of profound interest to the great mass of taxpayers, there is a vast deal of misinformation in the public mind which, evidently, it is not the intention of "city electricians" to dispel. No difficulty should be experienced in explaining this condition of affairs. These gentlemen naturally seek to perpetuate and extend their influence, and a more promising field than that opened up by the prospect of municipal ownership of lighting and railway plants is hardly imaginable. Investigation will show that these public officials are much more accomplished politicians than electricians, and that by reason of their inexperience in engineering work and their lack of training in sound business principles they are really incompetent to conduct lighting and railway projects or similar enterprises upon a large plan. It should be remembered that most of them are old-fashioned telegraph operators who secured appointment when the fire-alarm system was the only branch of the city service that employed electricity, and as their attention since that time has been occupied largely in their efforts to retain their positions, they have made little progress in the acquirement of electrical knowledge and have not begun to keep up with the development of the art. These are plain facts about the class of public officials known as "city electricians." There may be exceptions, doubtless there are, and we sincerely wish there were more; but it is safe to say that there are very few officials of this class who would be entrusted by a private corporation with the management of an extensive lighting or street railway system.

Why then should cities repose this trust in them and place the community at their mercy? If the question could be fully explained to the people there would be no danger of action favorable to municipal control being taken, but the public does not comprehend the full significance of the movement. These men are active and aggressive, they exploit their ideas in newspaper interviews and display a tenderness for the dear public that is really touching. But the fact remains that they are personally interested in the success of the movement, which is the true explanation of their solicitude.

Those who realize the danger of this movement to established interests should be equally active in offsetting the mischief that these politicians are constantly working. The best way to do this is through organized movements systematically conducted. The plans of the Northwestern Electrical association are eminently practical, and if they can be put into execution there will certainly be a revulsion of feeling. This is, of course, the reason why "city electricians," East and West, are criticising the action of the association so severely. The National Electric Light association and the American Street Railway association are interested in this movement; they have been similarly engaged for some time. Why would it not be a good plan for these organizations to combine their resources and join in a common movement?

Barrett Still in a Corner.

Another week has passed and John P. Barrett has made no attempt to satisfactorily explain his action in awarding the contract for fire-alarm boxes for the city of Chicago at a price $4,125 in excess of that of the United States company for boxes that were pronounced by competent experts to be in every way equal to the Gamewell apparatus selected. Barrett has displayed considerable activity, however, in abusing those who have exposed the methods of his department, and in misrepresenting the facts in the case. He has, nevertheless, failed in his effort to divert the investigation from its original course. The insurance men persist in their demands that the changes suggested by the *Record* commissioners be embodied in the new boxes. Barrett, of course, objects to this because it will be official recognition of the commissioners' report and an acknowledgment that the boxes were faulty in design and construction. Then, too, the reports from other cities upon the question of price confirm the charge that Chicago is paying $100 for the same type of box that other cities purchase for $50.

Litigation Over Car Heating Apparatus.

On February 15th in the United States Circuit Court at Utica, Judge Coxe handed down a decision in favor of the American Electric Heating corporation as against the Consolidated Car Heating company of Albany. The title of this suit was the Dewey Electric Heating company vs. the Albany Railway company. The former is owned by the American Electric Heating corporation and the latter uses the Consolidated Car company's heaters. The object of the suit was to prevent the use of a switch in combination with electric heaters for varying the amount of heat in cars as covered by patent No. 464,247, granted to Mark W. Dewey, December 1, 1891, for "Improvement in Electric Heating Apparatus." In granting the decree Judge Coxe said: "The invention consists in combining any desired number of distinct sections, each complete in itself, adapted to be connected with the supply conductors in series, in multiple arc, or in multiple series with a switch for controlling these connections, and an indicator operated by the movement of the switch to show how the connections stand." * * * "Matters relating merely to form and location are not the essence of the invention." * * * "The defendant's combination operates in substantially the same manner and accomplishes the same result as the combination of the claim."

This is considered an important victory by the American Electric Heating corporation, as it affects many installations made by the Consolidated company as well as those of others using a combination switch to vary the heat.

Searchlight in Mimic Warfare.

On February 12th the dynamite cruiser Vesuvius made five unsuccessful attempts to run the blockade at Charleston, S. C. The conditions were exactly reversed from those of Friday night, as the air was free from fog or mist, and the searchlights worked perfectly. For a stretch of nine miles the waters of the Atlantic in front of Charleston harbor bristled with floating forts, and gleamed with the restless arrows of dozens of searchlights. The line was established at seven o'clock and the Vesuvius was sent out to sea. The searchlights began at once to play over the waters. It was about 7:33 when a light from the Maine stopped in its wanderings and streamed long and steadily upon one spot. The cause was soon known. She had caught the Vesuvius. A red and green signal told the tale, and the lights of the fleet, turned upon the spot, brought the white hull of the cruiser into full view. The Vesuvius put up her lights fore and aft and went to sea again for another trial. The next time she got past the line and was nearly out of danger when the light of the Amphitrite caught her. Three other attempts were made, and each time the blockade runner was quickly caught.

American Institute of Electrical Engineers.

At the meeting of the Institute held in New York on February 17th, 75 members and guests were present. A paper was read by John W. Howell on "Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them." The discussion was participated in by Messrs. Kennelly, Colby, Wolcott, Sheldon, Wirt and Burnett.

At the meeting of the executive committee in the afternoon, the following-named associate members were elected: Albert W. Brown, New York, N. Y.; Alva C. Dickey, Munhall, Pa; Budd Frankenfield, Madison, Wis.; Wm. Howe Ripley, New York, N. Y.; Edward B. Rosa, Middletown, Conn.; Christopher Van Deventer, New York, N. Y.; George K. Woodworth, Hagerstown, Md.

The following-named associate members were transferred to full membership: Philip Dawson, London, England; Lucius T. Gibbs, Milwaukee, Wis.; Frank J. Sprague, New York, N. Y.; Edward Andrew Leslie, New York, N. Y.

Steam Railroads and Electric Motors.

Charles P. Clark, president of the New York, New Haven & Hartford Railroad company, appeared before the legislative committee on railroads at Hartford on February 16th on behalf of the Consolidated company in its warfare upon electric railway interests. He related the experience of the Consolidated company in the introduction of electric motors on the Nantasket Beach line, the extension of the experimental road and the adoption of the third-rail system—all of which had been attended by singular success. He predicted that the locomotives now employed by steam roads would find their way to the scrap-heap and be replaced by electric motors. This prediction was based upon the experience of the Consolidated company. Concerning the plan of extending street railways and connecting the lines of different towns throughout New England into a network of roads, President Clark said:

Now a word about the New England road and about this particular business. If New Britain and Hartford were all that were involved in this question, there would have been no building at Berlin. Hartford has 70,000 people. New Britain has, say, 25,000, but the business between New Britain and Hartford we know is 350,000 people a year. That is hardly enough to maintain a power plant and all that it involves. It is the first in this part of the state, although it is number three. It is an experiment in the line of the duty and obligation of steam railroads to serve the public better by frequent communication by car service than by train service. The power house is located where the third rail can go to Middletown, to Meriden, run the entire street railroad of Meriden, go up to New Britain, west to Plainville, we know not how far. The transmission of power by the third rail has gone farther than the electricians thought. How far it will answer without commercial loss nobody yet can tell. But the investment is not a large one. A power house costs the same whether put up by a street railroad or a steam railroad. The charges that have been paid by the steam railroad for lighting its different stations, when the lighting is done as an incident from this same power, will pay the interest upon it. Two motor cars, of which there are eight times as many idle all the winter, owned by our road, will give a 15-minute service between New Britain and Hartford. If the petitioners wish to go on and construct their road, I want them to understand exactly what they are experimenting with, but the greatest of all questions is whether this house-to-house business done by lines through the streets or frequent traffic is most desired by the public.

I am president of the New England as well as the New Haven road. But I do not appear because we simply do not want these charters granted. The gentlemen should understand what they are to meet. It will go down in the future, if I do not fail in my prediction, that at Hartford in the state of Connecticut was constructed the first practical demonstration of the subordination of electricity to the standard steam road. Instead of having six, eight or 10 trains a day, all the New England roads could afford to run, we may develop a service and a traffic of 10 times that. The business may not want to come by us; it may want to go by the other line, but we shall learn whether it is any use anywhere to proceed farther with these investments and make these constructions, which are infinitely cheaper than building a new railroad, and which, where there is a sufficient volume of business, is undoubtedly practicable and profitable for steam railroads. It is in that spirit that we proceed to lay this third rail. It is with the same interest and with the same views that the managers of these properties have endeavored to serve the public by an expense of millions of dollars in creating additional facilities within the last 10 years.

We do not like this parallel scheme, we do not want it, but if it is carried forward it will remain for the public to determine by their use whether it is worth while for steam roads to make further developments. All the machinery from Berlin can be transferred to a location where the road now does a business of 4,500,000 instead of 350,000 passengers a year, and all the possibility of loss to the New Haven road will be the transferrence of these generators to that point.

The Electric Light company at Coon Rapids, Iowa, will furnish six street lights for one month for $2 per light. They are to be 32 candle power.

Chicago Electrical Men's Dinner.

An enjoyable evening was passed by the electrical men of Chicago at the Union League Club on February 17th. Dinner was served in the tower room, and the table was arranged in the form of an incandescent lamp. The following-named gentlemen attended: B. J. Arnold, F. B. Badt, W. E. Baker, Charles H. Besley, J. R. Chapman, Thomas H. Creden, A. B. Chandler, Max Eichberg, Dr. Elisha Gray, Charles E. Gregory, W. L. Gibbens, Angus S. Hibbard, W. S. Hine, Samuel Insull, Martin J. Insull, A. L. Ide, W. A. Jackson, W. A. Kreidler, W. J. Lloyd, S. J. Larned, Charles Munson, John B. O'Hara, Charles T. Page, R. E. Richardson, B. E. Sunny, Frederick Stevenson, C. H. Sewall, A. S. Terry, Henry S. Towle, A. D. Wheeler, J. B. Wallace.

In addition to those mentioned the following-named gentlemen had accepted invitations, but were prevented at the last minute from appearing at the banquet: Charles A. Brown, F. G. Beach, William G. Beale, Frank B. Donahoe, William H. McKinlock, R. K. Rockwell, J. E. Zeublin, F. S. Gorton.

Dr. Gray, whose claim to seniority was generally admitted, presided, and as usual performed the duties of toastmaster in a very agreeable and acceptable manner. No set speeches had been prepared for the occasion, but the chairman succeeded in bringing out some excellent after-dinner speakers.

An amusing incident of the evening was the ringing of several large electric bells which had been arranged under the table for the occasion. The first allusion to the tender years of the industry represented by the assembled gentlemen brought forth such a din of noises from hidden sources that the speaker was startled and the company convulsed with laughter. The alarm was sounded every time during the evening that reference was made to the "infant." Exception was made in the case of the telephone men, however, upon the request of Mr. Hibbard, who explained that the constant ringing of bells disconcerted them, as it revived unpleasant memories of the days when the sound of a bell meant that a subscriber had a complaint to make.

It seemed to be the general opinion that an improvement in the electrical business world was already noticeable and that the prospect was much more encouraging than it has been at any time since the hard times set in. An air of relief pervaded the assembly and the company seemed to be in exceedingly good spirits. It was agreed that the idea of having an occasional dinner of this kind was an excellent scheme, as it tended to promote friendly relations between representatives of all branches of the business, and it was determined to hold another banquet on the second Wednesday of May. A proposition to have the affair conducted under the direction of F. B. Badt was received with universal approval. The arrangements for the dinner on last Wednesday evening were made by Prof. Badt, and the company passed a special vote of thanks to him and his associates, Messrs. Sunny, Brown, Insull, McKinlock and Hibbard, who comprised the banquet committee.

Northwestern Alumni of the Massachusetts Institute of Technology.

On the evening of February 20th the annual dinner of the Northwestern Association of the Alumni of the Massachusetts Institute of Technology was held at the Technical Club, Chicago. Over 60 members were present, and seven states were represented. The election of officers resulted as follows: President, B. R. T. Collins, '88; vice-president, R. H. Pierce, '85; secretary and treasurer, E. M. Hagar, '93; executive committee, H. H. Cutter, '81; Solomon Sturges, '87; John L. Shortall, '87, and Louis A. Ferguson, '88. Frank Wells, the retiring president, began the speech-making, and introduced the guest of the evening, Prof. Robert H. Richards of the Institute, who had been in Chicago at the annual meeting of the American Institute of Mining Engineers.

Prof. Richards paid a feeling tribute to the late Gen. Francis A. Walker, and a silent toast to the memory of the deceased president of the Institute was drunk at the conclusion of Prof. Richards' speech. Other speeches and addresses were delivered as follows: L. A. Ferguson, "Electricity Direct from Coal;" R. H. Pierce, "Diffusion of Light;" S. D. Flood, "The New South and Its Future;" J. A. Carney, "The Etching Process as Applied to the Inspection of Iron and Steel;" Solomon Sturges, "My Career at 'Tech';" M. L. Cooley, "The Class of '87;" R. A. Shailer, "The Successful Engineer;" Dr. R. W. Hardon, "Medical Engineering;" Severance Burrage, "The Hoosier Schoolmaster." A zither solo was played by R. H. Richardson.

Insurance as Affected by Electrical Construction.[1]

By George S. McLaren

In giving a paper on electricity, as viewed from an insurance standpoint, I desire briefly to discuss the position taken by the underwriters in regard to its use and to mention a few of the greatest dangers to be avoided. Immediately insurance is suggested as a subject, either for conversation or as the topic of a paper, there arises a loud and prolonged wail against these grinding, far-reaching monopolists. Wm. J. Bryan's most vivid picture of a gold-bug hardly equals the image that is imprinted on the minds of many business men when they think of insurance companies; and the trouble is right here;

We do not consider that about ninety-nine per cent. of the business population of this world are in business to make money, few of us keeping occupied just for the love of work. The central station agent does not force current through streets and stores just to illuminate his town; he expects some financial return for his labors. The merchant does not use electric lights because he wishes to encourage their use, or just to increase the sales of some supply man, but because by employing those lights he can better display his goods, advertise in his show-windows and see to do his work. Even the manufacturers and dealers in electrical supplies dispose of their goods that they may reap some profit by the sale. And, though it may appear strange to many people, fire insurance companies are also in business to make money, and not simply to pay losses and prevent merchants from failing.

The trouble with us all is that each thinks everyone else is making too much money and that he is making too little.

Now each and every energetic business concern is trying to protect its business in all possible ways; by increasing its trade as much as seems advisable, by sending out agents to look after its business and by making as large a profit as possible on its sales. The insurance companies do the same as any commercial house. They try to write a large number of risks, and, probably owing to the peculiar nature of their business, they protect it more than any other organization.

Why, then, should the underwriters receive so much opposition to their work? Why not aid them in making their losses as small as possible, and in that way make them better able to give you low rates of insurance?

It is for these reasons that insurance companies have organized an electrical inspection department, trusting that by so doing they will benefit the insured and therefore better protect themselves.

It seems to me that the more insurance companies insist upon good, practical, safe wiring and use of electrical apparatus, the better it will be for the central station owners, the supply men and all concerned.

Let us take first the benefit to the station owner of a careful inspection of electrical equipments. When a building is being wired he does not have to keep a man constantly watching the work to see that it is done correctly, but when the time comes to connect the installation to his system, he simply inquires if the work has been approved by the underwriters, and upon an affirmative reply, the connection is made; but that is only the beginning. He knows that the building is inspected every so often, he knows that there is someone constantly on the lookout for trouble and defects over his entire system, and even watching the work of his own men, and many a leak and many a cause for serious trouble is brought to the notice of station owners by insurance inspectors.

And how evident it is to us all that the less trouble there is on an electrical system the cheaper it can run. If the mains and branches throughout the building are large enough to amply carry the current, and if there is no leak in the insulation, you can certainly furnish cheaper and more satisfactory light.

Then again the person erecting a building receives a great benefit from the underwriters in the electrical line as well as in many others. He knows in the first place that there will be no danger from the wiring, and that the work will be done according to the most approved ideas. He has, gratis, someone who watches his contractors and their workmen, and who is constantly looking out for his interests, and he always has the satisfaction of knowing his equipment is thoroughly surveyed at least once a year.

Even the supply man and the contractor (provided they sell good material and do good, careful work) are aided by the insurance companies, for the underwriters are always ready to recommend the best goods and the most reliable workmen.

Instead, however, of taking this view, many lighting companies try to furnish current to as many customers as they possibly can, and seem to base their probable profits by the number of lights on their system, instead of upon the actual cost of operating those lights. The company that takes on its system all sorts of equipments, composed of all kinds of absurd wiring, is not the company that will in the end make money; neither will the supply man who sells poor material or the contractor who does careless work profit in the long run. And here I would like to ask if, as an association, we cannot do something to raise the standard of electrical work and electrical workers. Why should there not be as severe a law in regard to the efficiency of electrical workers as there is concerning plumbers? Why should contractors be allowed to hire small boys to do a man's work? There is not one out of 20 of the boys (aged from 12 to 17 years) employed by electrical contractors who knows how to correctly make, solder and tape a joint, connect up simple apparatus, or even bore holes for bushings, not to mention not understanding the theory of what he is doing. Why should we not encourage the employment of good, reliable men instead of cheap, irresponsible labor?

I would now like to mention a few of the greatest dangers to be avoided in electrical construction work. Aside from the use of good material, if common sense were used to a greater degree in wiring, there would be little trouble. Many people consider that the greatest danger to be avoided is the possibility of a direct short-circuit. I do not believe this is true, for it has been my experience that short-circuits almost invariably take care of themselves by immediately blowing a fuse or melting one of the wires and thus cutting off the current.

More important points in wiring are the correct location of fuses, the grounding of wires the wiring of fixtures, the use of flexible cord, and the placing of inflammable material near electrical apparatus. Let us discuss them briefly in the order mentioned.

Cut-outs should be centrally located, of easy access, and entirely separated from inflammable material. They should never be scattered promiscuously throughout a building. Why there should be a desire to place cut-outs in the rear of shelves, where goods are sure to be placed against them, or between floors, or some such ridiculous place, I could never understand. Then where a wooden cabinet is used to hold cut-outs you will often see the back and sides of the cabinet lined with asbestos, while the door, which closes almost against the fuse, is left bare. I do not believe in even placing fuses in the canopies of fixtures or in rosettes for cord drops, especially in damp places.

Slow leaks and the grounding of wires on gas and other pipes cause a considerable loss each year. It is because the current consumed by these leaks is small but constant that there is so much danger in them. They do not take sufficient current to blow a fuse; but, instead, either form an arc or slowly work on the surrounding substance until they have become thoroughly charred and at last ignited.

Fixture work is an important branch of electrical wiring, and should receive more attention than is generally given to it. I have as yet failed to find an entirely satisfactory wire and insulation for this class of work. If some manufacturer would introduce an insulation of small diameter which could not be easily cut and was still moisture-proof, it would find a ready market.

The fixture men should use more care that all burrs are removed from the fixture stems; that the insulation is not peeled from the wire by drawing it through the fixture, and that their joints are correctly made.

The use of flexible cord in electrical wiring is a matter of much concern to the underwriters. The number of fires caused by its use is surprising. We are now advocating the use of a cord with a solid rubber insulation of at least $\frac{1}{32}$ of an inch in thickness, which in turn shall be covered by a braid.

The principal trouble with cords occurs in show-windows and in draping designs in stores. Electric lights certainly look very pretty peeping out from under a mass of cotton-batting or from a pile of ribbons, but that such use of them is dangerous few seem to realize. The danger arises from three sources: First, the cord may become damp or may be pierced by a pin or nail, or may even have a defective strand, so that it will be short-circuited or heated and catch fire. Second, the brass lamp sockets are not always in perfect order, or the cord attached to the binding screw may have a projecting fiber because the man who connected it was in too much of a hurry to solder the ends. In either case the socket becomes heated or burned out and the material touching it catches fire. For this reason it is best to use porcelain sockets in show-windows, theaters, etc. Third, the glass bulb of the lamp is liable to rest against some material which is ignited by the heat of the glass. Here I would like to read from a few experiments on the heating effects of lamps. A 16 candle power Edison lamp was screwed into a porcelain socket and lighted by the use of a 112 volt current, the lamp taking 48 amperes. The temperature of the room was taken and found to be 22° Cent. Different materials were then placed over and against the glass bulb, with the following results:

White tissue paper began to smoke after 3½ minutes, at a temperature of 60° Cent., and after six minutes at a temperature of 90° it burst into flame. Yellow woolen cloth smoked some after 8½ minutes at a temperature of 100°, but did not flame. It was badly charred, however. About the same result was reached upon using a mixture of cotton and wool. Black all-woolen cloth with a 32 candle power lamp, using 92 amperes, smoked freely at two minutes. After five minutes 100° was reached, and at eight minutes 150°, when the cloth burned. The same was tried with black all-silk goods, which, at 150° in seven minutes, only charred and fell to pieces without flaming. Cotton batting, with a 16 candle power lamp, smoked in two minutes at 70°, and in eight minutes, at 150°, it burst into flame.

A fire occurred very recently in one of our stores which is worth mentioning here. A bunch light composed of eight lamps and attached by a cord was placed on a pine box in such a position that two of the glass bulbs rested on the wood, and the current was turned on. In 15 minutes the box was in flames.

There are many more points in the use of electrical apparatus which cause trouble and which might be brought up for discussion, but I think four-fifths of the electrical fires originate from those mentioned.

In closing I would like to speak of the actual insurance of buildings and the effect electrical wiring and apparatus bear on the "make-up" of their rates. To explain more fully I will briefly give an outline of how rates on buildings are determined. First, please understand that buildings are not rated by any mere guesswork; they are compiled by carefully consulted, accurate tables, which have been deduced from statistics taken of all fire losses that have occurred for many years.

To illustrate this, the basis rate on a four-story building, whose area is not over 3,000 square feet, is 55 cents. If the building has a larger area, we add five cents for each 1,500 square feet or fraction thereof. If the building has deficient walls five cents is added for each story where they are deficient. Ten cents is added for a shingle roof and five cents for wooden cornices. For skylights, well boles and stairways we add five cents each, and for elevators 10 cents. Adjoining buildings cause an exposure rate of from five to 20 cents or even higher, to be added. To all this is added a rate for the occupancy. Then the improvements on the risk are considered. Ten cents is taken off for electrical alarm connected with fire department, five cents for combined standpipe and ladder, 10 cents for automatic batchways, 20 cents for watchman and clock, etc. The deficit rates are then added and from them is deducted the sum of the amounts taken off for improvements. The result is the rate charged.

As electricity is comparatively a new feature in insurance, there are comparatively few statistics in regard to losses from its use, so it would be almost impossible to state how much increase should be added to the rate on a risk where, for illustration, weatherproof wire is used instead of the best grade of rubber insulation, or when no spark arresters are placed on the arc lights. Moreover it would necessitate large tables and considerable trouble to add or deduct very small percentages from a risk for every defect or improvement in electrical apparatus, therefore it has seemed best to have a standard or set of requirements governing all electrical equipments and to require that this standard be strictly enforced. Where it is not carried out the insurance is canceled. There are a few exceptions to this rule, viz., where the general condition of the plant is not good a decided increase is sometimes added instead of the whole insurance being canceled. This more frequently is done in smaller towns than in larger cities. Then where a 500 volt current from the trolley wire is used one per cent. is added to the regular rate.

Discussion.

F. A. Copeland, La Crosse: We had occasion to wire a government building in La Crosse last year, and the government electrician specified particularly that the cut-outs should be placed in a canopy.

Mr. McLaren: I believe the correct place for cut-outs is in a properly made cabinet, so arranged that you can tell just where a difficulty lies in case one arises.

F. C. McMaster of Chicago: I would like information on the subject of having the construction men pass an examination such as is required of plumbers. I think it would help all the central station men, and would help the supply men in handling their goods if some such rule were to go through, because a majority of the worst work is done by irresponsible people, and if we could get rid of those irresponsible people in the electric business we would be able to sell a higher grade of goods all around and get our money for them.

Mr. McLaren: The only way to get at that would be for us as an association to try to get an act passed by the Legislature requiring an examination for all electrical workers. Only those who pass such examination will be qualified to install electrical equipment. I think that you would find that the contractors throughout the state would be willing to agree to that too.

George L. Thayer: The insurance inspectors of the eastern district of Iowa last year sent a man out on a tour of education. He proposed an ordinance for adoption by city councils, which provided that all contractors doing wiring should take out a license and should pay a fee of $20 a year for their licenses; and there were several schemes for the examination of the contractors. It depended upon the size of the town and the amount of wiring done. Through the adoption of that scheme they are getting a better system of wiring done throughout the territory.

H. L. Doherty of Madison: That may be a very nice thing for the insurance companies, but it certainly curtails the rights of central stations. The central station as it now stands, can have the work done by anyone and can protect themselves. If they do not want poor work done, especially when there is only one central station in a town, by requiring that certain conditions be complied with to have their approval of the work, they can insure good work being done. Almost every gas company around the country has its set of rules, and very often they post the names of gas fitters who can do the work, and if a man does not live up to the specifications they refuse to turn on the gas, or at least withold their approval from the work. Every specification in a great many cities, for buildings, is drawn up to be subject to the approval of the inspector of the gas company. When the thing is put in the hands of the council, the man who does the inspecting is very apt to be a politician, and we have all had some experience with politicians

Mr. Debell: It seems to me it would not be a very difficult matter to make reasonable regulations in that respect. I notice in Sheboygan, and I suppose it is so everywhere else, that the water companies, for instance, have regulations which are very simple and very effective. The plumbers are required to get a license from them and not from the city, nor from the state, nor from anybody else except the water company. The water company owns the pipes that are laid through the

1. Read before the Northwestern Electrical association, Milwaukee, January 22, 1897.

town, just the same as the central station company owns the wires that supply current through the town. Plumbers are required to get a license from the company, and they are not allowed to make connections to any pipes without permit. The only interest the lighting companies have is to see that the wiring is properly done, and that there shall be no leakage from the connection. This is not a matter for the municipality or state to take into consideration at all. Those pipes are owned by the water company, and they certainly can say whether this man or that man shall make a connection to their property, and I think the central stations could do the same thing without any legislation at all. If they refuse to connect their wires to dwelling houses or business places, unless certain regulations are complied with, nobody can stop them.

MR. MCMASTER: What Mr. Debell says is true in a great many cases, but in a large number of towns the stations are selfish in a way and will not, if they can possibly help it, allow a man to go in and do any work. In some of the stations they want to get the very cheapest stuff they can, too, and where a man will go from one town to another to bid on jobs, some stations won't let him in, and won't connect up with his work; and they won't do the class of work themselves that a thoroughly good construction man would be willing to do could he get the price. I think the only way to have that done is to have either the association take it up and secure the passage of such a law or have the construction men themselves do it. But I do not believe that it can be done by the construction men alone, because there is too much of the shyster element in the electrical business yet to really make a good step to the front on that.

MR. DOHERTY: The subject is being discussed from the standpoint of the central station only, to benefit the central station owner. We are not here to take action to benefit the supply business nor the insurance companies. Now if these central station men are not long-sighted enough to know what is good for them, we cannot help them any; but we want all the privileges we can get. We do not want any of our privileges curtailed, and if we want to see good wiring done the matter is in our own hands. If legislation is necessary, let there be an ordinance passed making the electric company the judge, or give it the privilege of refusing to connect its system to poor wiring. That gives us ample protection and does not subject us to the petty authority of some political ward heeler.

MR. CUTTER: I think honestly that the suggestion of this association working for a law of that kind is contrary to our best interests. We should oppose any such movement. We have already got disturbing elements enough. We have got the insurance underwriters telling us what to do, and now the politicians are telling us what to do. One insurance man says you must not put cut-outs in a canopy, while the state electrician says you must do that thing. Insurance and central station interests are really almost identical and are working nicely together; and the rules that are being established by working together will be for the interests of the central stations, but I think this association should be on the alert and should oppose any effort to make a law of the kind suggested.

PROF. JACKSON: One aspect of this affair strikes at the root of the matter and if properly considered by the central stations would practically remove most of the trouble. I have found through all this state and all through the western states and largely in the middle states, that not only do a large proportion of the contractors for wiring, in small towns at least, know very little of the details of the underwriters' code, but even the employes of the central station that have the inspection of the wiring after the contractors put it in, know little of the code in many cases. If that code were thoroughly drilled into the minds of the contractors by central station people and into the minds of the employes of the central stations, I doubt very much whether we would have much complaint regarding the dangers of electric wiring. The trouble is largely due to the lethargy of the central station managers themselves, though I do not want to attack them.

MR BEAN: Attack them, attack them, that is what we are here for.

PROF. JACKSON: It is time for them to wake up on some of these small details whose importance they have not yet realized on account of the difficulties under which they have been laboring in attempting to get dividends. But if you will take care of some of these small details you will find it easier to earn dividends.

T. F. GROVER, Wauwatosa: There is no excuse for any central station getting poor wiring done at this day. The central stations have the privilege of examining every job before connecting up; and if a man puts in poor wiring and it is inspected, there is no reason why the owner having the wiring done should accept it, and no reason why the central station should accept it. The man that has his building wired wants it safe, and if told by the manager of the electric company that it is not safe, he is not going to accept it, and there is no reason why we should connect that up.

Municipal Ownership a Public Misfortune.

[From the New York *Sun*.]

The municipal ownership of gas plants is a socialistic experiment which has attained some success in one or two small foreign cities, under totally different circumstances from those prevailing here. Wherever attempted in this country it has resulted in poor gas, jobbery and scandal. Every intelligent Philadelphian admits that the municipal ownership of gas in his city has been a public misfortune.

Incandescent Lamps.

BY FRANKLIN S. TERRY.

The subject of the incandescent lamp has been so many times and so ably treated from a scientific standpoint that I could add little that would be new, and I will, therefore, confine my attention principally to those points which will be of practical interest to the central station.

The making of an incandescent lamp requires more than 30 distinct processes, most of which affect its quality rather than its appearance. The character of the filament, the way it is flashed and the exhaustion may generally be said to have most to do in determining the quality, but the defect in a lamp may be traced to a defect in either the filament, the glass, the platinum, even the base, or due to poor workmanship in any one of the several processes in putting them together. An incandescent lamp is not so simple an article of manufacture as to make it reasonable to expect that all kinds will be the same in quality.

The electrical energy consumed in an incandescent lamp is transformed into light and heat. From three per cent. to five per cent. into light, the remainder, or from 95 per cent. to 97 per cent., into heat. As light is the only useful product, the incandescent lamp may be said to have a real efficiency of from three per cent. to five per cent.

An incandescent lamp may be operated at such a low voltage as to give heat, but no light. As the voltage is raised the filament will become hotter and the proportion of light will be increased, and this may be continued until the heat is greater than the filament will stand and it vaporizes. The filament that will stand the greatest degree of heat without vaporizing, other things being equal, is the best.

It is customary to state as the efficiency of an incandescent lamp the watts of energy required to produce one candle of light. By increasing the voltage we increase the light more than in proportion to the increase in the energy consumed, and the lamp is then said to be more efficient. For example, a lamp giving 16 candle power of light at 100 volts pressure and consuming 56 watts of energy, we would call a 3½ watt lamp. By increasing the voltage to 104 we raise the candle power to 20, the watts of energy consumed to 60 and the watts per candle would be three, and we would then call it a three watt lamp. If we should increase the voltage to 110, the candle power would be increased to 28, the energy consumed to 70, the watts per candle would then be 2½, and we would call it a 2½ watt lamp. There is no difference in the lamp itself between what is termed a 2½ watt lamp and what is termed a 3½ watt lamp.

As lamps are operated at a higher efficiency their defects become more apparent. If one is satisfied to operate a lamp at an efficiency of six or seven watts per candle (and such lamps are made and sold), what is in reality a very bad lamp may give such a customer good satisfaction.

The life of an incandescent lamp will be shorter as it is operated at a higher efficiency, or in other words at a higher voltage. For example, if at 3½ watts a lamp would have a life of 2,400 hours, at three watts it would perhaps have a life of 1,000 hours and at 2½ watts a life of 350 hours. It is not correct to take the life of an incandescent lamp as the measure of its quality. The practice of asking for guarantees of life has been nearly discontinued. The absurdity of such a guarantee is apparent when we consider that the conditions governing the life are under the control of the one operating the dynamo, and further, the life of a lamp is a factor of small relative importance in determining any economy in incandescent lighting. Every manufacturer can make long-life lamps, and those that are inferior in quality will usually be found to have a long life.

The decline in candle power is due to an increase in the resistance of the filament; consequently it then requires a higher voltage to produce the same amount of light as at first. Every incandescent lamp will decline in candle power after a certain number of hours burning. If operated at a higher voltage or efficiency the decline will be more rapid. The difference between different makes of lamps as to the rate of decline is due principally to the filament used and the exhaustion, and when operated at the same efficiency this rate of decline is the correct measure of their relative quality.

Sometimes central stations raise the voltage that they may give customers a better light, or in order to burn out the old lamps. This is bad practice, as it will result either in burning out new lamps or reducing the candle power until they will no longer give a serviceable light.

Lamps should be "smashed," as it is now usually termed, when they have ceased to give a satisfactory light and should be replaced by new lamps of full candle power. The life of a lamp is usually understood to mean the length of time it will burn without burning out. It would be better to use the term "useful life," which would mean until such a time as the candle power had declined so as to give an unserviceable or uneconomical light, which in most cases would be so long as the light was within 25 per cent. of the initial candle power.

The term "efficiency of an incandescent lamp" usually refers to the initial efficiency and as such does not signify very much. The real efficiency of a lamp is the average efficiency, being the light obtained for the energy consumed during its useful life.

The blackening of a lamp, as is well known, is due to particles of carbon that are driven off from the filament to the glass. This disintegration of the filament proceeds more rapidly when the lamp is operated at a higher voltage.

If a lamp bulb has become black, it is almost a sure indication that the lamp has been subjected to a higher voltage than was intended, or has been burning a good many hours. Blackened lamps should not be complained of as defective.

Probably there has not been an article written on the operation of incandescent lamps without calling attention to the importance of maintaining a uniform voltage, and still this is not fully appreciated in many central stations. The trouble is sometimes due to incorrect station voltmeters, sometimes to large pressure loss on the lines, and on alternating circuits may be due to poor regulation of transformers. Every central station should be supplied with standard portable voltmeters and frequent readings should be taken of the voltage at different parts of the line. It must be remembered that overrunning a lamp not only shortens its life but increases the resistance of the filament so that it will not afterward give its normal candle power at the normal voltage. A fluctuating voltage must always result in an unsatisfactory lighting service. If it would be an advantage to the central station to have a higher efficiency lamp, the first step to take in that direction is better regulation, which will result in the lamps being of higher efficiency when operated at the normal voltage.

In a paper read at your last year's meeting, Mr. Buckley recommended the use of 2½ watt lamps "and two watt lamps if you can obtain them." You all have two watt or 2½ watt lamps in your your stations now. Just increase the voltage at which they are burned until the energy consumed divided by the candle power of light gives you 2½ and you have a 2½ watt lamp. If you are using the best lamp you will have the best 2½ watt lamp that can be made. If you wish a 16 candle power 2½ watt lamp, order of your manufacturer a lamp that will give you 16 candle power at the voltage that you are operating and will consume but 40 watts. Any lamp manufacturer can furnish such a lamp, although all would not give equal satisfaction. They would differ in quality the same as other lamps differ, but the defects in a lamp are more apparent when it is operated at a higher efficiency. Mr. Buckley gave some figures showing the saving made by using 2½ watt lamps. The figures given exaggerated the saving, as no allowance was made for the more rapid decline in candle power of the 2½ watt lamps, which in practice will soon lose from 40 per cent. to 50 per cent. of their candle power. The customer that wants a light of 16 candle power will not be satisfied with one that gives but eight or 10 candle power, even if it may cost less to operate.

The 2½ watt lamp would not do at all on most central station circuits as they are now operated. When overrun in voltage they would be immediately burned out or the candle power would afterward be so low as to make the light unserviceable. A high voltage will injure so called high efficiency lamps more than those of lower efficiency. With better regulation you can use higher efficiency lamps, and it is profitable to operate lamps at as high efficiency as will give satisfaction to your customers. Probably a 3½ watt lamp will give the best satisfaction in most moderate sized stations as at present operated.

One difficulty in furnishing lamps to central stations is the lack of knowledge of how the station is operated. Often the voltage is higher or lower than is stated, due perhaps to an incorrect voltmeter, and lamps made for the voltage as ordered would not be satisfactory. Again the voltage may be irregular, and a lower efficiency lamp would be more suitable. If all central stations were operated the same it would be much easier to furnish a lamp that would always give satisfaction. This will, perhaps, explain how it is that a certain make of lamp is considered the best at one station and the worst at another.

One of the principal advantages of incandescent electric lighting over other forms of illumination is the readiness with which the electrical energy may be subdivided so as to give a light of such a candle power as may be desired. This desirable condition is not in many central stations taken advantage of to as full an extent as might be profitable. Lamps can be obtained of from four candle power to 500 candle power. In this country the 16 candle power lamp is the standard and is the lamp mostly used in both stores and residences. In some of the foreign countries the eight candle power lamp is the standard. In store lighting a bright light is wanted, and I predict that in the near future the standard for that service will be higher than at present, perhaps 20 candle power. In residence lighting the demand is for a certain number of separate lights, and that the monthly bills shall not exceed a certain amount. There are many places in residences where the smaller candle power lamps, consuming less energy, will give as good satisfaction as the 16 candle power. In decorative lighting and in sign work a small candle power lamp, even as low as four candle power, will give quite as good an effect as the 16 candle power, and with about one-third the cost for energy. It is wasteful to put in a lamp giving more light than the conditions require.

The practice of using an old lamp that is low in candle power in places requiring less light is not an economical one, as in most cases a new lamp giving an equal amount of light will save enough in energy to more than pay for the cost of the lamp. A lamp that has declined more than 25 per cent. in candle power should be thrown away—"smashed."

Managers of central stations frequently buy certain makes of incandescent lamps for the reason that they are one cent or two cents each lower in price, at the same time admitting that they are not quite so satisfactory in quality. I believe that this is very poor economy.

As the purpose of the business of central station electric lighting is to make a profit and pay dividends to the

stockholders, every intended economy must be judged by its effect on the profits or dividends.

Some time ago I obtained from a number of electric lighting central stations, statistics showing the capital invested and the results of their operation, and from an average of these I have made up some figures that I believe fairly represent the results that will be obtained in the average station.

We will take for our example a station having an investment of $100,000.

I found the average gross receipts of the stations above referred to was 26½ per cent. of the investment, or this station should have a gross income of $26,500.

The average price charged customers for energy was 15 cents for 1,000 watt hours, which would be equivalent to three-quarters of a cent per lamp hour for a 50 watt lamp.

The electrical energy that this station would supply to customers in a year would, therefore, be 175,666 kilowatt hours.

Operating expenses, including general expenses, taxes and ordinary repairs for the year, $14,700, or about 8⅓ cents per kilowatt hour.

If the business is profitable the earnings should be sufficient not only to pay dividends, but in addition provide for a reserve or sinking fund in order to return to the stockholders their original investment at the end of the natural life of the business, and the smallest amount that should be laid aside for this purpose is five per cent. of the capital annually, or for this station the sum of $5,000, or about three cents per kilowatt hour for the energy delivered to customers.

This would leave a sufficient amount to pay dividends at the rate of about 6½ per cent., which certainly is not too large, considering the character of the investment.

Now let us see what part of the cost of operating expenses is the item of lamp renewals.

A 50 watt 16 candle power lamp, we all assume, will have a life of 600 hours, or the total consumption of energy of this lamp during its life will be 30,000 watt hours.

If the cost of the lamp is 18 cents each, this will be equivalent to six-tenths cent per 1,000 watt hours, or 7⅗ per cent. (about one-fourteenth) of the operating expenses, or including the reserve fund, which is a legitimate item of the cost of operating, the cost of lamp renewals will be five per cent. (or about one-twentieth) of the total cost of energy.

What effect would one cent difference in the cost of each lamp have on the dividend rate?

Taking the total energy generated for the station referred to above, 176,666 kilowatt hours, and dividing by 30 kilowatt hours, the energy consumed by each lamp during its life, we find that this station would annually consume 5,888 lamps.

A difference in price of one cent per lamp would therefore amount in a year to $58 88 or one-seventeenth of one per cent. of the investment, or it would take 17 years for one cent added to the price of lamps to equal one per cent. of the capital stock.

Now let us turn to the question of quality. Are all incandescent lamps practically the same?

We know from experience and from tests made that they are not, but I may be able to show the probability of there being considerable difference in this way: It is ordinarily stated that the energy consumed by an incandescent lamp is transformed, about 95 per cent. in heat and five per cent. in light. Considering for a moment the lamp to be a device for generating heat, we would certainly expect to find that two different makes would differ from each other at least one per cent., or if one lamp transformed 95 per cent. of its energy into heat, we might reasonably expect another would transform 96 per cent. into heat. These would not then differ from each other very much in their general conditions, but one would transform five per cent. of its energy into light and the other four per cent., or in the amount of light produced for the same consumption of energy they would differ from each other 20 per cent. I have stated it this way to show that such a difference cannot be considered absurd.

What is the value of this difference to the customer?

If the customer pays three-fourth cent per lamp hour and a lamp burns 600 hours, he pays for the energy consumed for that lamp during its life $4.50, and as light is the only product that is useful to the customer, a difference of 20 per cent. in the amount of light obtained from two different lamps would be a difference in value to the customer of 90 cents.

I have seen tests of different makes of incandescent lamps showing even a greater difference than that stated above.

If the central station pays for the lamps and the customer for the energy, it might at first appear that a higher lamp cost, even if it did result in a better lamp and benefit the customer, would be an additional expense to the station for which it would receive no additional revenue. In considering this phase of the subject, we should have in mind that any probable difference in the cost of a lamp would, as I have shown, make but a very slight difference in the earnings of the central station, but a slight difference in the quality of the lamp would make considerable difference in the value of light to the customer. In other words, by a very small additional expenditure you would add considerably to the value of what you deliver to your customer.

I believe that it is a well established rule of business that those business enterprises are in the end most prosperous where the customers' interests are most carefully considered.

I remember several years ago being informed by one who had made a study of the operation of a number of large central stations, that those stations that were the most liberal in their lamp renewals were the most prosperous.

The use of a lamp that is inferior, I believe, will always result in reduced profits to the station even if the lamp should cost nothing.

Large expenditures are made to obtain economical generating apparatus for the purpose of converting electrical energy into light, and the device that must be depended upon to make the final conversion—the incandescent lamp—is often almost disregarded as a subject of careful study and investigation, although the results of the investment that has been made largely depend upon its operation.

The Telephone Situation.

[*Continued from page 119.*]

other as do the plow beam patents, and that, in consequence, the later Berliner patent is void, since the earlier Berliner patent is for the same invention.

Considering the future development of the transmitter, it will appear that if the Berliner patent is sustained it will be necessary for the competive companies to employ the magneto telephone or to develop some form of the liquid electrode transmitter adapted for practical use. Should the Berliner patent be detared void, either in the suit now before the Supreme Court or in a subsequent infringement suit, the microphone transmitter, being open to the public, will continue in general use.

Considering the remaining features which enter into a complete telephone exchange, the receiver is at present open to the public, there being no fundamental patent which covers the receiver. The controlling patents on the apparatus at the subscribers' station have expired, so that a complete subscriber's station outfit may be employed without infringing any patents. There are many patents on details of construction, but these cover only special arrangements and constructions not essential to the complete equipment of the system.

While there are a great many patents on the switchboard, there are none which cover the switchboard so broadly as to prevent the use of a switchboard and complete equipment in a telephone exchange. For small exchanges, where a single board is employed, the broadest patent now in force is the Eldred patent, No. 303,714, purporting to cover broadly the employment of means for cutting apparatus, such as an operator's telephone, calling generator, etc., into the circuit of the cords used for making connection between several telephone lines. To avoid infringement of this patent means must be provided for controlling the operator's telephone and the calling generator in circuit without looping into the cord circuit.

For large exchanges, where all of the subscribers' annunciators cannot be placed upon a single board, and a number of boards must be provided, a problem was presented which led to the invention of the trunk-line system, in which the subscribers' lines are divided into groups of lines terminating in spring jacks or connecting switches upon a separate board. Lines which terminate upon a single board may be connected in the usual manner by a pair of lugs connected by a flexible conductor. When it is desired to connect lines terminating upon different boards the connection is completed through a trunk line extending between the boards. This system of divided boards connected by trunk lines is not covered broadly by a patent.

In the early development of large exchange switchboards the multiple board was invented and is covered broadly by letters patent granted to Firman and numbered 253,575. According to this system, a number of boards are provided and each telephone line of the exchange is connected with a switch upon each board, each line being thus multiplied upon all the boards so that a connection may be made with any line at any board. Upon each board are provided the calling annunciators of a group of the subscribers, say 100, so that all calls initiating from the subscribers of any group will be attended to by the operator at the board upon which their annunciators are placed. The connection is usually made by placing one plug of a pair in the switch socket of the calling subscriber, while the other plug is placed in the socket of the called subscriber. The system is readily expansible by adding new boards and extending all lines to switch sockets upon the new boards.

Owing to the advantages of this system for large exchanges over the divided board system employing trunk lines between the boards, the latter system was practically abandoned for large exchanges until within a few years, and many patents have been granted covering every phase of the multiple switchboard. It is now found, however, that the divided board system, with some improvements, is quite as well adapted for large exchanges as the multiple board system, and, in many particulars, possesses marked advantages over the multiple board system; to such an extent, in fact, is this true that a number of the largest cities are now changing from the multiple system to the divided board system.

The result is that large exchanges, as well as small exchanges, can be installed without the infringement of any fundemental patents.

It thus appears that there are now in existence no patents which prevent the installation and operation of an exchange in its entirety, and that the only patent in any wise controlling in its scope is the Berliner patent, purporting to cover every form of microphone transmitter. While it is of the highest importance to the public at large to possess the microphone transmitter in the operation of exchanges, it is by no wise essential, and it is safe to say that should the Berliner patent be sustained, inventive genius will improve the magneto telephone or the liquid electrode transmitter to the degree which will place in the hands of the public at large a thoroughly successful transmitter.

Galvanic Plating of Aluminum.

Up to the present time the plating of aluminum has not been perfectly satisfactory, partly because of the nature of the baths employed, which attack the metal, but more especially because of a thin pellicle of the metal which prevents a perfect contact with the main body. Copper, deposited on aluminum by electricity in a copper sulphate bath, often scales off on the least flexion of the piece, or under the pressure of the burnisher. This covering of aluminum with copper possesses a peculiar interest, inasmuch as on this latter metal the deposition of silver, gold or nickel is easy of accomplishment. The lighter metal is especially valuable for a wide variety of uses in the manufacture of articles of luxury or convenience, and will be gladly accepted if presented under a more agreeable aspect, and free from the oxydation which is the result of exposure to the air. This problem may be solved by strict adherence to the following plan, according to *La Métallurgie:*

Having cleaned the aluminum in ordinary hydro-chloric acid, or better, in a warm, slightly concentrated solution of this acid, and afterward plunging it in a copper sulphate bath, a considerable amount of gas is disengaged and the aluminum is instantaneously covered by a coating of spongy copper which is not thoroughly adherent.

The same fact is not noticed if the metal is plunged into the copper solution without the previous acid treatment. It is not the same if the object is treated in the following manner:

The article to be coppered should be of pure aluminum and thoroughly cleaned in a hot solution of alkaline carbonate—soda or potash—and rendered porus and striated. This condition of porosity is essential to a perfect adherence of the copper.

The article is next washed thoroughly, carefully cleaned and brushed; then placed for a few moments in a hot one-tenth to one-twentieth solution of hydrochloric acid. This acid will attack the metal, covering it with a chloride of aluminum, which prevents oxidation. It is then immersed a very short time in a water bath. The excess of acid having been thus removed, it is now immersed in a slightly acidulated and concentrated solution of copper sulphate, while, with an abundant escape of gas, a beautiful and firmly adherent deposit of copper will be accomplished. This first deposit may in many cases be abundant, but it may be intensified by the electric current. The two operations may be performed at the same time, by connecting the electrical source when the article is first immersed. Nevertheless it is preferable to treat it by the two operations. Aluminum is not sensibly attacked when cold, by pure or dilute sulphuric acid, even in the presence of another metal, and does not precipitate the copper from the sulphate like cast-iron, zinc and some other metals.

The phenomena are entirely different when the surface of the aluminum retains traces of free chlorine, or chlorine in combination with the metal. The chlorine possibly acts as an intermediate vehicle which by reaction assists in the plating process. The chemical changes may be said to be that the chloride of aluminum is decomposed by the sulphuric acid, forming a sulphate of aluminum, which is in turn dissolved, the chlorine is freed, and the copper is deposited upon the now thoroughly pure metallic surface, solidly and smoothly. This bath should not be too far prolonged, as the evolution of gas, consequent on too long an immersion, will tend to raise scales of copper, and damage the work. The first layer, obtained in a few seconds by simply dipping, should be carefully washed in running water before placing the object in the electrolytic bath.

Copper aluminum (six per cent. copper) utilized where greater strength is required may also be as readily coppered as the pure metal. This should be cleaned in hot dilute nitric acid, which gives it a beautiful and remarkably white surface. It will now accept a copper covering by simple immersion in the copper sulphate, after dipping in the hydrochloric bath, but this metal also will act satisfactorily in the electrolytic bath.

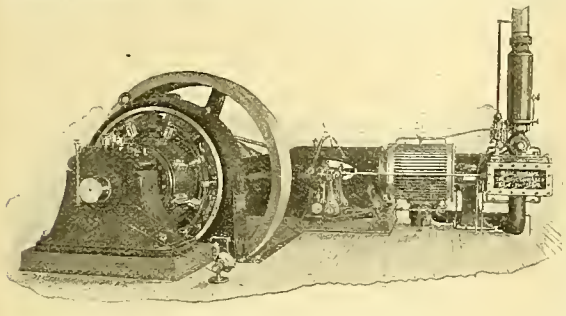
Curious phenomena are mentioned by Van der Weyde, who noticed that in a bath with an anode of copper and a cathode of aluminum the resistance is the same as though both poles were of copper, the intensity of the current depending on the number of elements and the resistance of the bath; while, on reversing the current, the oxygen liberated from a pellicle offers such resistance as to almost entirely stop the current flow.

It is said that the street railway company at Des Moines, Ia., will extend its Scott street line to the starch works and brick works in Chesterfield this year.

Ball Side-crank Medium-speed Engine.

The engine shown direct-coupled to generator in the illustration is built by the Ball Engine company of Erie, Pa., and is especially well adapted for electric railway service, having a liberal apportionment of metal in all parts and strongly made to withstand the sudden shocks and fluctuating load of railway work. The high-pressure valve is of the double-face telescopic type, receiving the boiler pressure on the inside, there being a sufficient amount of unbalanced area on the faces so that the force of the steam on the inside forces the two faces apart, causing each to rub against the seat with a sufficient force to keep the surfaces polished and steam-tight through the entire life of the engine. The low-pressure valve is of the common letter D type, with improved construction and proportion; it is provided with a round relief area upon its back, operating against the chest cover, thus insuring a large, well proportioned valve that runs with great ease, yet follows up its wear without attention from the outside. The governor is placed in the flywheel. The connecting rod is of forged steel, with both ends cut out to receive the crank and crosshead boxes. The adjustment of boxes on both ends of the rod is by means of wedges operated by T-pointed setscrews, placed in the top of the rod, which move the wedges up or down, for adjustment, and as the movement of the wedges is in the same direction, the length of the rod is not changed, nor is the position of the piston altered. The adjustments can be made by hand with a great degree of accuracy. The crosshead is of the double-plate pocket type, and is provided with taper shoes to compensate for any wear that may occur against the guides, the shoes being of cast-iron and running surfaces spotted with genuine babbitt metal, the area of which is very liberal.

The crank-shaft is one solid piece of 40-carbon open-hearth forged steel from end to end, and ground to a perfectly round, smooth running surface. Surrounding the crank throw is a disk carrying sufficient amount of counter-weight to give a running balance to the crank and to the reciprocating parts, so there is no vibration to be communicated to the frame and other working parts of the engine. The introduction of the shaft into the engine is accomplished by arranging the shaft boxes in a large jaw cutting into the bed deep enough to bring the center of the shaft in a plane with the center line of engine, finished spots being provided to meet corresponding finished surfaces upon the cast-iron boxes.



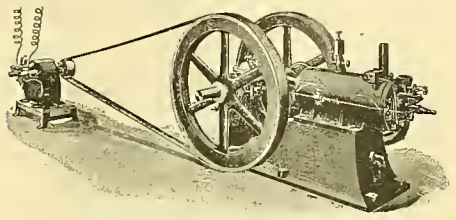
BALL SIDE-CRANK MEDIUM-SPEED ENGINE.

These boxes consist of one bottom, two quarter, and one top box, each of which is provided with removable babbitt metal shells upon which the journal bears. The adjustment of these boxes is accomplished by means of set screws, one of which operates (either in or out) a wedge which fits between the lower side of the jaw in the bed and bottom of lower box, two others operating wedges on the sides for the side boxes, and two which reach the top box, thereby giving for all positions of adjustment of the quarter boxes a full bearing for the shaft in the lower box.

It is understood the Postal Telegraph company will extend its system from Quincy, Ill., to Burlington, Ia., and thence across Iowa to Omaha.

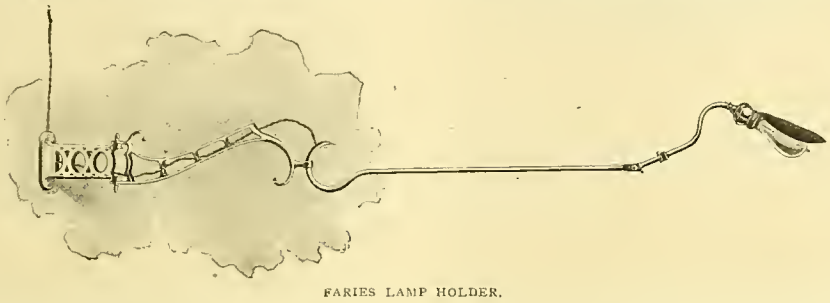
Chicago Gas and Gasoline Engines.

In the accompanying cut is illustrated the Chicago gas engine, which is said to contain a number of valuable features and which is in successful operation in almost every state in the Union. The material used in the construction of the engine is of the finest quality and all parts are replaceable. The crank shafts of the engine are made of low carbon tool-steel, being forged from one solid piece and slotted out. They are sufficiently strong to resist twice the strain that the engine could ever be called upon to withstand. The piston is made of fine close-grained charcoal iron with heavy lugs cast in the center to receive the wrist pin. There are but two valves on the engine, which need no lubricating or cleaning whatever, as they are raised squarely from their seat and consequently there is no sliding motion to need lubrication.



CHICAGO GAS AND GASOLINE ERGINES.

The engine is especially adapted for electric lighting purposes and has an improved governor which divides the charge of gas and air as a governor on the steam engine governs the pressure of steam on the cylinder. It is claimed that this is a special feature which can be found in no other gas engine and is fully covered by patents. All the working parts of the engine are exposed to view and can be easily gotten at. The J. J. Norman company, 60-62 South Clinton street, Chicago, which manufactures these engines, carries in stock sizes from two to 55 horse power, and can make larger sizes on short notice.



FARIES LAMP HOLDER.

What Becomes of Old Copper Wire.

Within the last few years the use of copper wire in connection with electric railways and electric lighting plants has increased so remarkably that the question, What becomes of this wire after it has served its purpose? is, perhaps, more interesting than the ordinary reader imagines. It may not be generally known that there is a firm in Chicago which makes a specialty of buying copper wire and burned-out incandescent lamp bases from electric lighting and railway companies and handles over 1,000,000 pounds of wire annually. This firm is the Swarts Metal & Refining company, 120-122 West Lake street. The company has built up an excellent reputation and claims to be the only concern exclusively in this line. It has men who carefully inspect the wire, and such as has any life remaining in it is sorted, rerolled and sold for use again. Old lamp bases are of value only for the platinum they contain. From other scrap the company makes a high-grade of anti-friction babbitt metal for high-speed dynamos The Swarts company has established an excellent reputation throughout the United States, as well as in foreign countries, and those who have once dealt with the company are invariably permanent customers .All electric railway and central station managers will find it greatly to their interest to communicate with the Swarts company if they have any old copper wire or other scrap metals to dispose of.

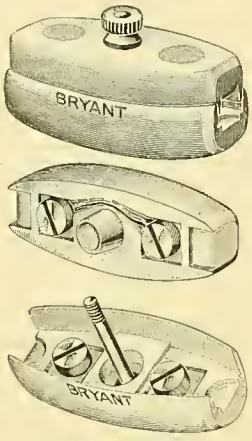
Bryant Bug Cut-out.

Among the numerous specialties placed on the market recently is the Bryant bug cut-out manufactured by the Bryant Electric company of Bridgeport, Conn. Illustrations presented herewith show the device in detail, both closed and open. The advantages claimed are as follows: It is impossible to short-circuit, has only one nut to remove, the fuse is placed in the cover instead of in the base, and it is not necessary to remove connecting wires to replace a fuse. These features would seem to commend it to the trade as a very useful device.

Faries Lamp Holder.

The Faries universal lamp holder is said to be the best thing yet invented for the purpose of supporting incandescent electric lamps. It is simple in construction and operation, but, as shown in the illustration, attractive in design and appearance, and very effective in enabling the light to be shifted instantly to any point desired. The holder has met with general approval since it was first introduced a year or so ago, and large numbers are in use throughout this country and Europe.

The holder is manufactured and sold by the Faries Manufacturing company, Decatur, Ill., and this company is continually getting up new designs and improvements of it. It has recently issued a catalogue showing several new designs. The holder is made both plain and ornamental—the former for use in shops and factories and the latter for use in offices, stores and residences. The picture shows a form of the holder intended for office use.

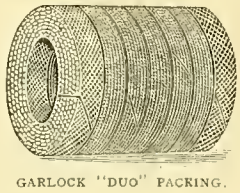


BRYANT BUG CUT-OUT.

Those interested in the subject should address the Faries Manufacturing company, which will be pleased to mail a catalogue free which will give full information.

Garlock "Duo" Packing.

In this progressive age steam engineering has kept pace with the other branches of mechanics, arts and sciences. With the single cylinder a decade ago steam was seldom used above 100 pounds pressure, but with the introduction of the compound, triple-expansion and quadruple-expansion engines came high-pressure steam.



GARLOCK "DUO" PACKING.

One change usually necessitates others, and this universal law has been followed out in the rapid improvements of the steam engine. With the adoption of the multiple cylinder type of engine, heavier and better material has been used in their construction. This also applies to the design, strength of material and construction of the modern steam boiler, steam pipes, fittings and appliances. Valve and piston rod packings that were suitable for packing glands of engines working at a pressure under 100 pounds to the square inch have failed to meet the requirements of the modern steam engine using steam from 125 to 250 pounds to the square inch. Of course with the increased pressure of steam there is a much higher temperature. The Garlock Packing company, fully realizing the importance of meeting all the requirements for a high-pressure packing, has been experimenting for a number of years and has produced and placed on the market the Garlock "Duo" packing, which is particularly adapted for high-pressure steam and hot-water purposes, but working equally as well where a low pressure is used. The Garlock "Duo" packing is guaranteed to give perfect satisfaction under all conditions and in all places where a high-pressure or hot-water packing is used.

New Automatic Motor Starter and Quick-acting Switch.

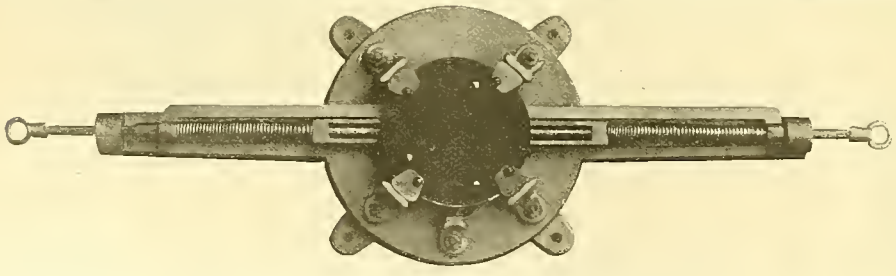
The Automatic Switch company of Baltimore, Md., is showing the latest designs of Whittingham automatic motor starter and quick-acting switch, and they are herewith illustrated.

The operative principle of the starter is now so well known that a description is hardly necessary, but for those not familiar therewith it should be stated that the automatic movement of the rheostat is accomplished by means of a small belt connected directly with the motor, whereby each revolution of the motor armature cuts out, with absolute certainty, a predetermined part of the starting resistance. This method possesses advantages which are of great value in elevator and pumping work, as it acts as a safeguard against too rapid starting and forcing the motor under an over load. The main feature to be commended is that the resistance is always cut out directly in proportion to the speeding up of the motor and can never crowd on current before the armature is prepared to receive it. The construction of the starter has been so modified as to do away with all outside wires, the resistance terminals being completely encased and protected from accidental damage, and the bearings are of graphite and require no oil.

The new type of quick-acting switch shown in the picture embodies a number of novel and valuable points. It is designed especially for use in connection with electric pumping and elevator work, and its construction is such as to make it particularly adapted to the exacting requirements of such work. The movement required for the operation of the switch is a reciprocating one, having a stroke of about two inches, which allows the use of a sliding rod passing through bearings on the base casting, and stopping thereon at each end of stroke. The switching mechanism is thus relieved entirely from any strain or pull of the actuating rope, and is operated by the compression springs arranged to give the quick motion when making or breaking the circuit. The contacts of the switch are pure copper castings, turned up to a true bearing surface, and arranged to engage each other under spring tension, in a manner somewhat similar to the ordinary street car controller, each set of contacts being detachable and renewable without disturbing the operating parts of the switch.

By means of this switch, in connection with the Whittingham automatic rheostat, open tank and pressure tank elevators may be operated automatically with satisfaction. It will also be found equally useful in maintaining a certain level in the supply tanks of automatic sprinklers, etc.

Such electric freight elevators as allow the motor to run continuously during the time the elevator may be used can be more economically operated if arranged to be started and stopped from any floor as needed, and the apparatus shown is just what is required for the purpose. A rope passing up the elevator shaft and over pulleys at the top and bottom is connected to the rings of the quick-acting switch, which, in connection with automatic starter, enables anyone wishing to use the elevator to safely start the motor, and afterward cut off the current consumption when it is of no service. There are instances where this saving has amounted to between $200 and $300 in one year. The automatic motor starters are made in sizes ranging from two horse power to 30 horse power, and the switches supplied in two capacities, viz., 20 amperes and 60 amperes.



NEW AUTOMATIC MOTOR STARTER AND QTICK ACTING SWITCH.

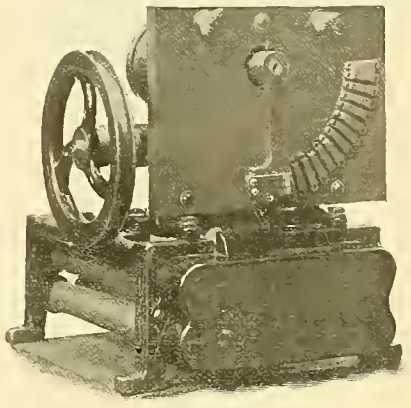
The Automatic Switch company will shortly put upon the market a new form of automatic reversible controller and reversing switch, which combines many desirable features, and will furnish reliable means of automatically handling elevator motors without the use of dash-pot or moving magnets.

The paper to be read before the Chicago Electrical association at its meeting at 1737 Monadnock building on March 5th will be on "Electrical Resonance," by Kempster B. Miller.

Exhibition in New South Wales.

On June 26th a very important exhibition is to be opened in the Exhibition building, Prince Alfred Park, Sydney, N. S. W., and will be continued during the months of July and August. It is intended to embrace engineering in all of its branches, and the exhibits will consist of raw materials, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relative to scientific, mechanical and educational works, in classified sections. There will be no charge made for space allotted, but the executive committee reserves the right to limit the space of each exhibitor.

The object of the exhibition is solely for the advancement of engineering science and the promotion of a general and practical education. It will be non-competitive, and will be under the patronage of Governor Hampden.



NEW AUTOMATIC MOTOR STARTER AND QUICK-ACTING SWITCH.

Group IV. includes prime movers, comprising steam engines, gas, electric, hydraulic, hot air, etc., water wheels, turbines, windmills, etc., steam generators, accesories of engines and boilers. Group V. comprises machine tools, hardware, edge tools, cooking appliances. Group VI. comprises railway, tramway and vehicular appliances, and embraces rails, switches, signaling apparatus, locomotives, goods wagons, carriages, etc., tramway cars, rails, permanent way, brakes, couplings, ticket checking apparatus, bicycles, tricycles, and autocars.

Electricity, group IX., occupies an important place and embraces generators, conductors, testing and measuring apparatus, telegraph and telephone apparatus, electric lighting apparatus, electro-metallurgy and electro-chemistry, transmission, distribution and utilization of power, lightning conductors, electro-thermic apparatus and electro-medical apparatus.

There are important groups also covering hydraulic machinery, refrigeration, chilling and dairying appliances, drawings and photographs, scientific appliances and educational appliances.

The executive committee has appointed Edward Noyes of Sydney, N. S. W., its representative in Europe and America for the purpose of obtaining exhibits. All communications on the part of intending exhibitors may be addressed to him, care of the Standard Air-brake company, 100 Broadway, New York, and they will receive immediate attention.

This opportunity gives American manufacturers of electrical and engineering apparatus an excellent means of displaying their wares in Australia, as the exhibition will be very largely attended.

The electric light company at Shenandoah, Iowa, objects to the demand for lower lighting rates to the city, and says that the rate of $1.25, the present one, is absolute cost, and that the lights will be taken out rather than run at a loss.

CORRESPONDENCE.

New York Notes.

NEW YORK, February 20.—It does look as though the often-promised but much-deferred improvement of transforming the Manhattan elevated roads in this city from steam locomotive to electrical operation is measurably in sight. The *Sun* is pretty good authority on elevated railroad matters, and the *Sun* says that the successful Chicago system is to be tried. A meeting of the executive committee of the board of directors of the Manhattan Railway company was held on Tuesday afternoon, it seems, and General Manager W. J. Fransioli presented a report on the electrical system used for operating the elevated railroads of Chicago. This report was so favorable that, by unanimous action, the executive committee decided to give the same system a practical trial in New York, and the general sentiment at present seems to indicate that a similar system will ultimately be adopted on all the Manhattan lines. It has taken the Manhattan people a long time to get at the truth, but they seem to be awakened now. "I am not yet acquainted with the details of any practical trial the directors may decide to give this system here," said Mr. Fransioli in an interview, "nor do I know of any contracts or other arrangements contemplated. The General Electric company are makers of the plants I have been investigating, and they have been figuring on the trial on Thirty-fourth street, but I don't know that we would get our plant from them. We own several available sites for power stations, notably one on the East Side at 129th street and one on the West Side at 155th street." Uncle Russell Sage confirms the report. "Our primal object in operating the elevated road," says he, with bland benevolence, "is safety, the second aim is comfort, and the third is economy. We anticipate that the electrical system will make no difference in the first two of these, but it will result in a gain of maybe one-half in economy."

The Consolidated Traction company in Jersey City contemplates building an elevated road over the surface trolley road, to run from the junction of Communipaw avenue and Grand street, Jersey City, to the ferry. The company has two objects in view—to relieve the traffic on the surface road and to make better time to the ferry. The only engineering problem to be solved is how to cross the elevated tracks of the junction railroad on Grand street. It will probably be necessary to go over the junction company's tracks. It is expected that the trip from the junction to the Pennsylvania railroad ferry, which now requires 20 minutes, could be made on the elevated road in five minutes. Express cars from Bayonne, Newark and on the belt line would run on the elevated tracks. If the property owners on Grand street and the city authorities consent; the company will probably begin the work in the spring.

De Lancey Nicoll, as counsel for the Metropolitan Street Railway company, which has been indicted for maintaining a public nuisance in the curve at Broadway and Fourteenth street, appeared before Judge Cowing on Thursday. Mr. Nicoll withdrew the plea of not guilty and asked leave for six days' time in which to enter a demurrer or a motion to quash the indictment. This was granted. M. S.

Milwaukee, Wis.

MILWAUKEE, February 20.—After a trial that extended over a period of three weeks, the jury in the case of the seven men charged with shooting Motorman Breen from ambush south of the city during the street railway strike last spring failed to agree, and a new trial will have to be held. The jurors were out almost three days and three nights, and it is said that four of them held out from first to last against any verdict except absolute acquittal. The shooting of the motorman, it will be remembered, occurred at night Strikers placed a tree across the track, and when the car came up they began throwing stones at the crew, who were, of course, non-union men. It was claimed on the part of the defendants that Conductor Schwartz was the first to fire, but, be that as it may, the prisoners were all well armed, and for a few moments there was a rapid fusillade. The prisoners made confessions soon after they had been arrested, and these confessions, each shorn of all statements that implicated anybody except the person making it, were admitted in evidence. The men admitted that they went out on Howell avenue to burn the wire, cause trouble generally and to teach a lesson to the non-union men, who, they declared, had been impudent to them. They claimed, however, that

there were a number of other men in the party, and that, while they sat on the embankment, the others were in the pit, and it was they who fired the shots which wounded the two car men. The marks of the bullets, they contended, showed that the shots were fired from below. The car which figured in the scene was afterward wrecked in a collision and destroyed. The defense tried to make a point against the state out of the fact that the car had been allowed to disappear.

A bill to compel the Wisconsin Telephone company to make connections with the wires of other companies has been introduced in the Legislature. The bill provides that companies engaged in the telephone business in the state shall receive and transmit within the state messages to and from other companies engaged in the telephone business, and to furnish to such other companies connections with its own telephone exchange. The company desiring such service shall first extend one or more wires, as may be necessary, to the nearest junction box or central office of the company of whom such service is desired, the latter company to be obliged to complete the telephone and switchboard connections. Thirty days are allowed the two companies to agree upon suitable compensation for this service. If they do not agree within this time, then the railroad commissioner of the state, upon application of any interested company, shall prepare a reasonable schedule of tolls or charges, which, when promulgated by the commissioner, shall have the force of law. This schedule shall be changed only by agreement of the interested parties or by the commissioner himself. It is expressly provided, however, that the commissioner shall allow the company on whose line the business originates not less than 25 per cent. of the total charge. Settlements under this arrangement are to be made monthly, and a delay of 30 days will work a forfeiture of the rights conveyed under the proposed bill. Any toll-line charge or other charge made against any individual user of a telephone shall be a lawful charge against the exchange of which he is a subscriber. Any company failing to comply with the provision for the joint transaction of business shall forfeit not more than $100 nor less than $25 for each day that it pursues such course, and if it persists for 30 days in such refusal, it shall forfeit its charter.

Another bill which has been introduced in the Legislature seeks to modify the powers of the common councils of Wisconsin cities in the matter of granting street railway franchises. No common council, the bill provides, shall have power to grant a franchise to any such company unless owners of property representing more than one-half of the frontage on the street shall consent in writing to the construction of tracks in front of their property.

President Matthew Slush of the Milwaukee, Racine & Kenosha Railway company has for a third time applied to the Common Council of Kenosha for a franchise through that city. In the new ordinance the company does not ask for any particular route, a point upon which it and the council had split before; it persists in a desire not to give purely local service to Kenosha, and it asks for a 50 year franchise instead of a 25 year franchise, which was all the council was willing to give it. None of the Kenosha aldermen oppose the proposed road, but they want to get as favorable terms as possible for the city and are particularly opposed to giving a franchise that will run for 50 years. They state that that is much longer than the usual period of such a franchise. The Council is not likely to budge, and the company may have to accept its terms in the end.

On May 1st the Wausau Telephone company will make a material reduction in telephone rentals. The new rates will be $2 50 a month for business telephones and 75 cents a month for private houses. The exchange is now earning a net profit of $230.70 a month after paying a monthly dividend of 1½ a month or 18 per cent. a year. The company was established by men who were dissatisfied with the Bell company's service and rates.

The Dane County Telephone company is contemplating the construction of a toll line from Madison to Lodi, providing the people of the latter place will purchase $500 worth of toll books. The Portage Telephone company intends, in the near future, to build a line either to Baraboo or to Kilbourn. This would give the patrons of the Portage company connection with Madison, Lodi, Kilbourn, Baraboo and other intermediate points between Portage and La Crosse.

The gross earnings of the Milwaukee Electric Railway & Lighting company for the 12 months which ended December 1, 1896, were $1,211,763.29. The amount that it has paid into the city treasury in lieu of all taxes is $19,613.48, being at the rate of one per cent. on the first $250,000, 1½ per cent. on the next $500,000, and two per cent. on all earnings in excess of $500,000. The earnings of the company for the 12 months ended December 1, 1895, were $1,286,880.01, the tax upon the amount being $21,987.60.

The gross earnings of the Oshkosh Street Railway company for the 12 months which ended December 1, 1896, were $17,896, the tax thereupon being $178.96. The Marinette Street Railway company paid taxes on about $21,000 of earnings.

The annual meeting of the Milwaukee Electric Railway & Lighting company was held in the city during the present week. The old directors whose terms had expired were re-elected, and at a meeting to be held in New York officers will be elected. The transfer of the Pabst heating and lighting plant and of the Wauwatosa electric line was consummated during the Milwaukee meeting. C.

PERSONAL.

Louis A. Ferguson of the Chicago Edison company has been suffering from a severe attack of tonsolitis during the last week.

J. J. Nate, well known to Chicago telephone men, has succeeded H. C. Dodge as general superintendent of the Standard Telephone & Electric company of Madison, Wis.

E. Ward Wilkins, of the Partrick & Carter company of Philadelphia, passed through Chicago early in the week on his return journey from the Pacific Coast. Mr. Wilkins made a brief stop in this city and reported a very successful trip. He placed a number of agencies for his company's supplies in California and other states, and returns East well satisfied with the result of his tour.

William Taylor of New York, who will have an opportunity to make a trip around the world at the expense of the *New York Telegram* because he came nearer McKinley's plurality than any of the thousands of other guessers who entered the contest, was formerly a Chicagoan. He was assistant manager of the Electrical Supply company, later the Ansonia Electric company of this city, and afterward of the firm of Taylor, Dee & Mack, dealers in electrical supplies.

The following named out-of-town visitors registered at the headquarters of the National Electric Light association, New York, for the week ended February 19, 1897: A. M. Young, Waterbury, Conn.; H. B. Cram, Boston, Mass; Guy L. Feldman, Newark, N. J.; H. W. Wheeler, Boston, Mass.; J. E. Lockwood, Detroit, Mich.; Dr. Louis Duncan, Baltimore, Md.; Charles E. Bibber, Boston; G. H. Watson, Matteawan, N. Y., G. E. Newton, Hartford, Conn.; M. J. Perry, Providence, R. I.; H. A. Wagner, St. Louis, Mo.

Mr. Edison has many curiosities and memcotoes, picked up in different parts of the world, and tokens of remembrance from distinguished visitors to whom he has extended courtesies. There is a phonograph cylinder in his laboratory that is just now of interest in view of the fact that Prince George of Greece has become a central figure in the European war cloud. It contains the prince's address to Mr. Edison, on the occasion of his visit to this country in 1891. The prince passed part of one day in Mr. Edison's laboratory. The phonograph interested him immensely. He heard it grind out the speeches of celebrated men, and then he called for music. The phonograph responded with the then popular "Where Did You Get That Hat?" Prince George then talked into the receiver, saying in Greek: "Hail, Edison, greatest of inventors. George, Prince of Greece, salutes thee."

ELECTRIC LIGHTING.

The consolidation of all the electric lighting interests on Staten Island was practically completed when the big uncompleted building at Livingston, begun three years ago by Erastus Wiman, was bought in by the New York and Staten Island Electric company on February 13th. This company was recently organized for the purpose of acquiring the electric lighting interests on the island. The sale was made by Albert B. Boardman of the firm of Tracy, Boardman & Platt receiver of the Wiman electric properties. There were present at the sale Erastus Wiman, Col. G. B. M. Harvey, the head of the new company; Austin B. Fletcher, representing the unsecured eastern creditors of Mr. Wiman, and other interested parties. The only bid was $1,000, made by Paul Cravath, for the new company. The liens against the property aggregate less than $39,000. The property sold includes nearly 400 feet of valuable water front and a large brick and granite structure, two-thirds completed, planned by Mr. Wiman to be one of the most substantial and complete electric power plants in the vicinity of New York. The consolidation includes the Electric Power company, the old Wiman plant at St. George, which supplies the villages of New Brighton and Edgewater; the Staten Island Electric Light company, the plant at Port Richmond and the Richmond County Electric company, which recently established a plant at New Brighton and is an offspring of the Staten Island Electric Railroad company, of which Colonel Harvey is president. It is understood that Edward P. Doyle is to be general manager of the consolidated companies and that Mr. Wiman will retain some interest in the new concern. It is also announced that work will be commenced at once to complete the Livingston plant and that it will have an equipment sufficient to furnish the entire island with light.

TRADE NEWS.

The D. A Kusel Telephone Manufacturing company, St. Louis, Mo., has just accepted an order for a complete telephone exchange equipment from the Sorento, Ill., Telephone company. This order, the Kusel company states, was secured through its advertisement in the WESTERN ELECTRICIAN.

The General Incandescent Arc Light company of 572-578 Fifth avenue, New York, has devised and perfected the Bergmann enclosed arc lamp for constant potential direct current circuits. The new lamp burns from 100 to 150 hours with one set of carbons and operates with a potential of about 80 volts. Several handsome designs are shown in a pamphlet on the subject just issued by the company named.

A new company, the Ahlm-Edwards Electric company of Medina, O., has come into the field with a line of multipolar dynamos and motors. The dynamos are designed principally for small isolated lighting plants, and are well adapted for gas engine driving. The motors are provided with adjustable bases and can thus be easily fastened to walls or ceilings. This feature is especially commended, although the machines are said to be well built in every particular. A descriptive catalogue is sent on application.

President Robert Fessenden of the Hope Electric Appliance company of Providence, R. I., was in New York last week. Mr. Fessenden reports that the outlook for business with his company has never been as bright, and the number of orders as large, as at present. In order to meet the increase in trade, arrangements are being perfected to enlarge the capacity of the factory, and, that a more proper distribution of the company's production may be made, agencies will soon be placed in New York, Chicago, and other central distributing points. The Hope Electric Appliance company has a reputation second to none in the manufacture of arc cut-out boxes, mast arms and high and low-tension current knife switches.

The Fischer Foundry & Machine company of Pittsburg, Pa., builder of the "Fischer" single and four-valve engines, desires to contradict certain unfounded reports that have been in recent circulation, to the effect that the manufacture of engines has been discontinued by the company. On the contrary, it may be stated that additional valuable features have been introduced, which, combined with the already known merits of the original makes of these engines, especially adapt them for electric lighting and street railway purposes. An inspection of the company's shops in Pittsburg reveals a thriving and prosperous industry, and the business outlook for 1897 is flattering. Foster & Louis, general western agents, have offices at 1000 and 1002 Fischer building, Chicago, where the many friends of the Fischer engine, and in fact all visitors, will be cordially welcomed.

The importance of a suitable carbon electrode for industrial electrolysis becomes evident with the increasing production by electrolytic methods of either chemicals or metals in this country. Hugo Reisinger of No. 38 Beaver street, New York, who is well known to the electrical trade for his "Electra" arc light carbons, has had great success in the introduction of his carbon electrodes, which are used in the electrolytic production of aluminum, copper, chlorate of potash, etc. The carbon electrodes supplied by him are made of pure carbons. They are homogeneous throughout, of the highest conductivity and have long life. The European factory which Mr. Reisinger represents in this country has the greatest facilities for turning out large quantities of these carbon electrodes, and, among others, has a running contract to supply all the carbon electrodes used in the famous aluminum factories at Neuhausen, Switzerland.

Since the world began people have racked their brains over puzzles of all descriptions, and things have not changed in this respect, for the person is yet to be found who does not enjoy studying out a really clever puzzle and then "springing" it on some friend and watching him do likewise. Most good puzzles cost money, but the Clayton & Lambert Manufacturing company of Ypsilanti, Mich., is sending out one gratis, to all who ask, that is a "poser" to the uninitiated. This puzzle was accidentally discovered in the manufacturing establishment of the company named. Two of the hose bands used in the Ypsilanti hose repair outfit were found one day interlocked in a manner that would rack the brain of a Philadelphia lawyer to undo them. This queer and self-planned puzzle has been studied out and will be sent to any address, with directions of operation, upon receipt of a two-cent stamp. The company requests that the WESTERN ELECTRICIAN be mentioned when writing for the puzzle.

The People's Electric company of Madison, Wis., desires to have it stated that it will continue to handle the specialties which it has carried since its organization, with others added. The many friends and patrons of the People's company will be pleased to learn that the capital of the company has been materially increased and that F. H. Ford, the new president, will have full charge of the business. Mr. Ford is thoroughly awake to the wants of the trade in the Northwest, as he was formerly the secretary and electrical engineer of the

People's company. Since the company was first organized, several years ago, it has built up an excellent reputation in the trade and at the present time it is doing a flourishing business. Every effort will be made to increase this trade, and the long list of well-known specialties which the company handles, coupled with its excellent facilities for prompt shipment, will doubtless make the concern even a more important factor in the supply business than it has been heretofore. A catalogue will soon be issued.

BUSINESS.

An electric light plant has lately been placed in the Wauwatosa County Insane Asylum, Wisconsin. The Ball Engine company, Erie, Pa., furnished the engines.

H. J. Gorke, who for several years was general manager of the Electrical Engineering & Supply company of Syracuse, has opened an office in the Bastable Building at Syracuse, N. Y., as a manufacturers' supply agent, and has secured a number of first-class specialties, which he will present to the trade in Central New York. Mr. Gorke is well known in the electrical trade, and his enterprise will undoubtedly win him success.

H. M. Underwood & Co., 204 Dearborn street, Chicago, have had several applications for the new regulating socket of the Pacific Electric company, which they represent in this section, and the outlook for a fine business is encouraging. They have also good returns on the No. 7 Espersen adjustable shade lamp, which is attached directly to the present fixtures, being the only adjustable shade lamp on the market that is plugged into the socket directly, requiring no standard of its own to obtain the desired result.

The manufacturers of the Packard lamp have always had the reputation of doing something very handsome in the catalogue line, and this reputation has been maintained by the appearance of their catalogue for the season of 1896-97. This catalogue is a little more pretentious than any of its predecessors, and many of its pages are devoted to general data on incandescent lamps and other valuable information. The Electric Appliance company has prepared a special discount sheet for this catalogue, giving the present market prices on high-grade Packard lamps, so that the catalogue when supplied with this discount sheet makes a complete lamp reference book. It will be sent to the trade on application.

The Orne Electric Construction company, Owings building, Chicago, manufacturer of Orne's intercommunicating telephone system, has just secured an order from Siegel, Cooper & Co. of Chicago for over 30 telephones to connect the different departments in their establishment. It is claimed that Mr. Weber, the engineer for Siegel, Cooper & Co., made thorough tests of many of the interior telephone systems on the market, and that the contract was finally awarded to the Orne company as the result. The Orne system is meeting with great favor in Chicago, and is in use by such well-known houses as Sprague, Warner & Co., New York Life Insurance company, Atchison, Topeka & Santa Fe Railroad company, W. M. Hoyt company, Chicago & Alton Railroad company and Carson, Pirie, Scott & Co. It is said that over 3,000 instruments are connected by the use of this system in Chicago.

The Dearborn Electric company, 19 Quincy street, Chicago, is at the present time one of the busiest houses in the supply business. The company is receiving orders from a great many users who were never heretofore on their books. This agreeable change to the Dearborn Electric company is due to the fact that the company is handling quite a number of well-known specialties, such as Sunbeam incandescent lamps, New England switches, Herlimann batteries, Bishop wires and many others equally meritorious. The prospects of the company are better than they have ever been before, and as the Dearborn company makes it a point to fill all orders with the greatest promptness, it is suggested that those in need of supplies send for the monthly price-list. The company will move on or about March 15th to its new store, 330 Dearborn street, where it will have better facilities for filling orders and supplying the wants of its customers.

James C. Wormley has been appointed general agent for the new Shelby lamp for Cook county, Ill., and the state of Minnesota. Mr. Wormley's connection with the incandescent lamp industry dates back a number of years to the time when he handled the Universal lamp made by the Universal Electric company, Cleveland, Ohio. It will be remembered that the Universal company was burned out and ceased the manufacture of lamps some time ago. Since then Mr. Wormley has handled several makes of lamps, but as the Shelby Electric company of Shelby, Ohio, has in its employment Joseph Hardwick, the old superintendent of the Universal company, Mr. Wormley feels particularly elated at securing the agency for the Shelby company, as he can again supply a lamp similar to the Universal. The Shelby Electric company appointed Jas. C. Wormley & Co. agents for the state of Minnesota, owing to the fact that the latter firm has a well established agency in St. Paul. Mr. Wormley is considered one of the most energetic men in the incandescent lamp business in Chicago, and with his large acquaintance and wide experience in the business it is safe to predict that the lamp which he now handles will find ready purchasers in the territory covered by Mr. Wormley. The Shelby Electric company claims for its lamps longer life and a higher efficiency than that of other makes.

ILLUSTRATED ELECTRICAL PATENT RECORD.

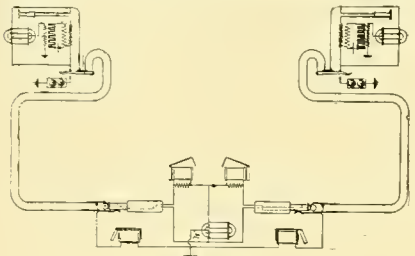
Issued February 16, 1897.

577,033. Illuminated Sign. Curtis Holland, Millis, Mass. Application filed March 17, 1896.

A frame or holder adapted to be connected with the socket of an incandescent electric lamp, and having a pair of jaws and a sign-plate detachably held by the jaws.

577,037. Electric Switch. Charles D. Jenney, Indianapolis, Ind. Application filed April 7, 1896.

The combination is claimed of the lever, the pivoted locking-arm formed with a joint near one end, the magnet for holding the device in position to lock the lever in one position, and mechanical means for holding it in the other.



NO. 577,101.

577,077. Electrical Warp Stop-motion for Looms. Alpheus C. Shuttleworth, Philadelphia, Pa. Application filed April 30, 1894.

A magnet is so placed as to be in close proximity to the ends of the heddles at the termination of each shed, and electrical connections are established between the magnet and stopping mechanism to actuate the mechanism and stop the loom when a heddle comes in contact with the magnet.

577,081. Electric Controller. Elmer A. Sperry, Cleveland, Ohio. Application filed September 21, 1896.

A cylinder is provided with contacts for establishing connections of the motor circuits; brushes engage with the contacts, and means are provided for changing the relation between the brushes and the contacts on the cylinder by a movement of one relative to the other in a direction transverse to the plane of rotation of the cylinder.

577,101. Telephone System. William W. Dean, St. Louis, Mo. Application filed September 19, 1896.

Factors in this arrangement are subscribers' stations, each having a primary circuit including a transmitter, thermal generator and the primary helix of an induction coil, a common source of current, a conductor leading from the source of current to the subscribers 'stations, and heating conductors, one at each subscriber's station in circuit with the conductor and source of current, and adapted to heat the thermal generators.

577,102. Party-line Telephone System. William W. Dean, St. Louis, Mo. Application filed September 19, 1896.

The electric circuit consisting of two limbs or sides adapted to be formed into a metallic circuit, and a group of high resistance signal bells connected with the outer portion of the circuit, an inner group of low resistance signal bells included in the circuit, relays, one for each limb, connected between the groups, and each when operated acting to diminish the resistance of the other limb, means for sending pulsating current of either polarity over either of the limbs, and means for at the same time directing battery current over the limb corresponding to that over which the signaling or pulsating current is being sent to operate the proper relay, whereby either bell of the low resistance group may be operated without ringing any other bell of either of the groups.

577,119. Electric Brake. Elmer A. Sperry, Cleveland, Ohio. Application filed February 19, 1895.

An auxiliary field coil of relatively high resistance is employed, and brushes and contacts for including the coil in circuit with the motor armature at the "off" position of the controller.

577,128. Signal. Paul G. Feuerstein, Milwaukee, Wis. Application filed October 26, 1896.

A clock whose hands are electric conductors that travel against the contacts on the dial, a switchboard, electric signal wires and an electric split plug for connecting switchboard contacts with signal wires comprise the invention.

577,130. Space-block for Armatures. Henry Geisenhöner, Schenectady, N. Y. Application filed November 20, 1896.

This construction consists of a main portion of cast metal, having recesses or seats for the teeth or projections of the space-block, and teeth or projections of strips of metal secured to the cast portion.

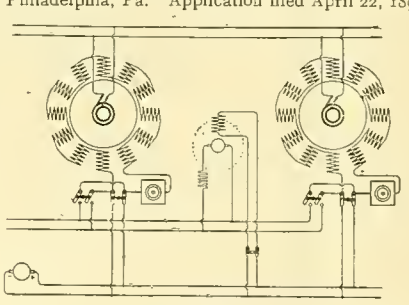
577,141. Means for Preventing Destructive Field-magnet Discharges. Frederick Mackintosh, Schenectady, N. Y. Application filed October 31, 1896.

Included in circuit with the field magnet coils and the exciter is a secondary source of electromotive force interrupting the circuit of the exciter, causing the secondary source of electromotive force to energize the field coils and decreasing the secondary electromotive force.

577,148. Binding-band for Armatures. Henry G. Reist. Schenectady, N. Y. Application filed November 18, 1896.

Many turns of wire having one side slightly longer than the other provide the means to secure the adjacent ends of the bands.

577,159. Incandescent Electric Lamp. Charles S. Dolley, Russell Hawkins and Thomas M. Lightfoot, Philadelphia, Pa. Application filed April 22, 1896.



NO. 577,141.

Two non-conducting plates are employed, one or both of which may be either transparent or translucent, and from between which plates the air has been exhausted; a filament is compressed between the plates, a hermetically sealed frame extends around the outer edges of the plates, and connections for electric wires are provided.

577,186. Process of Electro-depositing Aluminum. Caleb G. Collins, Woodsburg, N. Y. Application filed May 18, 1896.

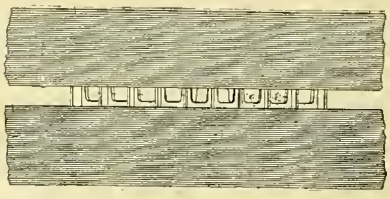
An electric current is passed successively through a positive solution containing a salt of aluminum, a porous partition and a negative solution containing potash and phosphate of aluminum.

577,214. Resonant Electric Circuit. John S. Stone, Boston, Mass. Application filed September 10, 1896.

A resonant electric circuit containing inductance resulting from the magnetization of iodependently magnetized paramagnetic material.

577,231. Telephony. Walter L. Bradshaw, Cincinnati, Ohio. Application filed March 30, 1896.

One claim is as follows: In a telephone system of the class described the push-button in combination with the receiver, the hook, ringing battery, line, plate, line spring, drop spring and drop.



NO. 577,130.

577,282. Electrical Battery. Edward Burnet, Wigan, England. Application filed November 30, 1895.

A cell is formed with a socket in its upper opened end with the electrodes, and a tray supporting the electrodes and closely fitting within the socket, and having a flange exteoding over the walls of the cell to prevent leakage into the tray.

577,284. Conduit Sheathing. Horace B. Camp, Akron, Ohio. Application filed February 10, 1896.

A conduit is described that is suitably metallically sheathed, and has the sheathing composed of two sections, the ioner section bent laterally and outwardly near its longiiudinal edges, and the other section suitably shaped to embrace the longitudinal edges of the inner sheathing section, and extending beyond the edges of the inner section a suitable distance and terminating in laterally and outwardly projecting flanges.

577,317. Electric Furnace. Francis J. Patten, New York, N. Y. Application filed September 15, 1896.

Two or more carbon pencils are connected through independent electric circuits to a source of electric current, the circuits including a liquid commutator, whereby the pencils can be given current singly and in groups successively in rotation.

577,370. Electric Furnace. Francis J. Patten, New York, N. Y. Application filed November 6, 1896.

The lower electrode is an inclined block or slab over which the material is fed, and the upper electrode consists of a series of plates having their lower edges transverse to the movement of the material; means are provided for passing a direct current through the electrodes and for creating a reversing magnetic field having its lines of force transverse to the upper electrode, whereby the arcs produced are caused to reciprocate across the material being operated on.

577,371. Electro-magnetic Arc Controlling Device. Francis J. Patten, New York, N. Y. Application filed January 15, 1897.

This method of imparting a reciprocating movement to an arc between electrodes consists in causing the arc to traverse a fixed magnetic field, the lines of force of which are substantially transverse to the direction of the arc-producing current and reversing or alternating the arc-producing current.

Western Electrician.

EVERY SATURDAY.

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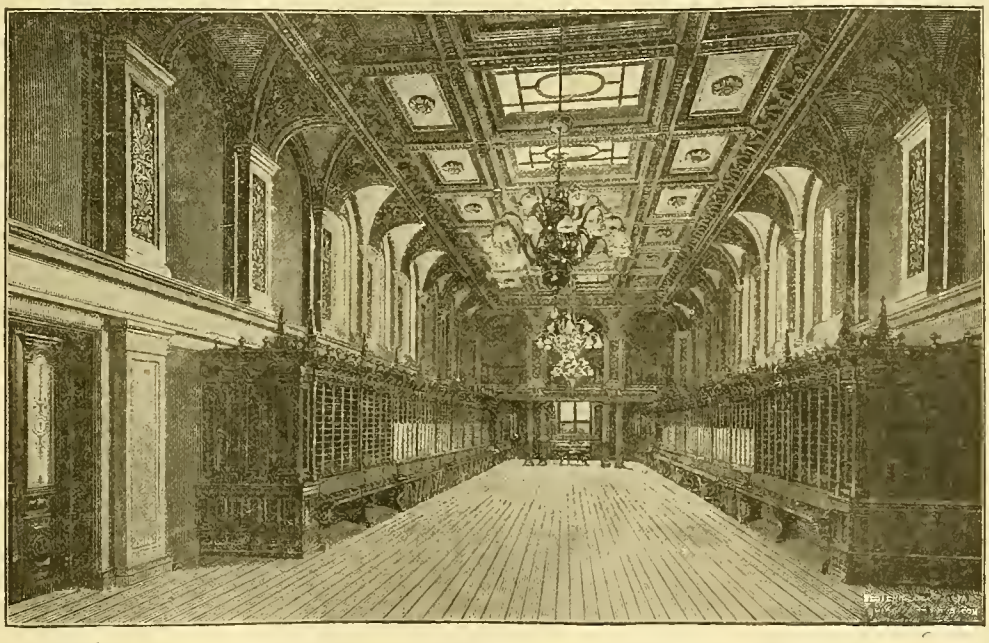
Telephony in Stockholm.

The beautiful capital of Sweden claims many points of distinction, but there is none more worthy of consideration, especially at the hands of Americans, than the remarkable telephone system that has been developed by her energetic citizens. It is admitted that in Stockholm the telephone is proportionately in more general use than in any other place in the world. It may be remarked incidentally that the experience acquired in this work has proven many of the theories concerning commercial telephony to be erroneous, and that the conspicuous position which Sweden occupies in the telephone world to-day is due entirely to the enterprise and courage of those who departed from the accepted lines of practice and determined to apply to the telephone business the same rules that govern other commercial enterprises.

When the telephone was introduced in Sweden in 1880, it was regarded as an expensive luxury, almost a scientific toy, and for three years, while the International Bell Telephone company enjoyed a monopoly, it made comparatively little progress in securing recognition as a commercial agent. It was only when competition appeared that the real advantages of the instrument were made known to the people. In Stockholm the General Telephone company was formed, and in Gothenburg, the next town in importance, a co-operative association was tried. This latter plan found general favor and was introduced throughout the kingdom. The General company was equally successful in the capital. Rates were reduced from about $44 to $27 per year, and as a result the new company secured as many subscribers in a few months as the Bell company had gotten in three years. The next year the General company had three times as many subscribers and the Bell system had made no progress whatever. Moreover, the new corporation proved a profitable investment, to the astonishment of the Bell company, which never played an important part in the affairs of the city, and which was soon absorbed in the General company's system. That corporation has now 15,000 instruments in use, which is really a remarkable showing, considering the fact that the population of the city is only about a quarter of a million.

Extension of the system beyond the city was opposed by the government telegraph department, which had determined to enter the telephone field, and, in consequence, the General company was obliged to abandon its plan of establishing a complete network of telephone lines throughout the kingdom. However, it was given permission to extend its lines in the territory surrounding Stockholm within a radius of 70 kilometers, 43.5 miles, and that district to-day enjoys the distinction of having the best telephone service in the world. It should not be imagined that the company has an exclusive franchise in this territory. As a matter of fact, the government engaged in active competition with the General company, put in metallic circuits, provided direct connection with subscribers on its lines in other parts of the country, and placed its rate of yearly service $5 lower than the General company's. The latter concern at once improved its service, replaced its grounded wires with metallic circuits and gave free connections throughout the territory in which it operated, but did not reduce its price. The result of active competition during the first four years is interesting as showing the inability of governmental systems to compete with private management. Despite the advantages possessed by the state, the General company increased its service by the addition of 3,150 new subscribers, while the government succeeded in getting only 2,000.

Many features of the telephone service in Stockholm are not to be found in American practice, yet they may be of sufficient interest to warrant brief mention here. One of these is due entirely to the geographical conditions. The city of Stockholm, which is one of the most beautiful of the world's capitals, is built principally upon several islands between the Baltic Sea and Lake Mahar, and this circumstance has earned for it the name of the Venice of the North. It is a much more enterprising and thrifty community than the Italian art center, and in many respects it is one of the most progressive cities of Europe. Communication between the several islands comprising the city, the main-land, and the villages on the numerous islands within the 70 kilometer radius, makes the use of submarine cable necessary. The General Telephone company has a small steamer which is equipped for laying and repairing submarine cable, and close attention is given to every detail of this important department. Many of the smaller islands near the town are the summer homes of wealthy merchants and public officials who find it necessary or convenient to have telephonic communication with the city.



TELEPHONY IN STOCKHOLM.—OPERATING ROOM OF PRINCIPAL EXCHANGE.

The principal exchange is located in the old part of the town, and judging from the picture of the interior, showing the operating room, which is presented on this page, it is a very substantial structure. It has been found necessary to enlarge this exchange several times, until at present the capacity is 15,000.

The first installation of telephones in Sweden consisted of Bell apparatus, but since the anti-Bell company gained a foothold, the Swedish telephone, made by Ericsson & Co. of Stockholm, has been adopted. It is an interesting fact that the Bell company uses the Ericsson transmitter on its lines with Bell receivers and magnets of the American type. The Swedish telephone is likewise used extensively in Norway, Germany, France and Japan, and has lately been introduced in this country by Whitman & Couch of Boston. The special features of this system have already been fully described in this journal. They have been developed by years of experience in Stockholm in the face of active and powerful competition which has made it absolutely necessary to give the very best service of which the condition of the art was capable. Some idea of the requirements of this service may be gained from the fact that in 1893 the number of connections made by the General company in Stockholm alone was 25,060,715. The profits of the company have increased steadily each year, making it possible to pay an eight per cent. dividend, to extend the business to an extent unprecedented elsewhere, to convert the system from ground return to metallic circuits and to establish a fund £108,411, in reserve for possible contingencies. This showing is certainly very flattering, and it is also encouraging to independent companies that contemplate a policy similar to that followed by the Stockholm concern.

Paris Exposition of 1900.

In a recent report to the government, copies of which can be had by application to the State Department at Washington, D. C., Samuel E. Morss, the United States consul-general at Paris, sets forth the general scope and character of the international exposition to be held in Paris in 1900, its organization, the financial arrangements, and the special features by which it will be characterized, and gives in detail the systems of classification and awards adopted, and all the regulations affecting foreign exhibitors. He says: "It is the avowed purpose to make the exposition surpass all its predecessors, both in France and elsewhere, not perhaps in extent or in architectural features, for it is conceded that in these respects there is little hope of eclipsing the great achievements at Chicago, but in its artistic aspects, in the logical, comprehensive and scientific system of classification and award, and in the uniformity and harmony of the whole. In a word, the ambition of the projectors lies chiefly in the direction of artistic excellence and general ensemble."

The matter of classifying exhibits has, Mr. Morss says, been profoundly studied. That of the World's Fair of 1893 is criticized as erring in the too minute subdivision of the classes. At Paris there will be 18 groups and 120 sections, as compared with 12 groups and nearly 1,000 sections at Chicago. The classification in the two groups of greatest interest to the readers of the WESTERN ELECTRICIAN—and it is a somewhat meager one—is given:

Group No. 4.—Materials and General Processes of Mechanics.

(19) Steam engines.
(20) Engines using other motive power (except electricity).
(21) General mechanical apparatus.
(22) Tools and implements of manufacturing.

Group No. 5.—Electricity.

(23) Production and mechanical utilization of electricity.
(24) Chemical electricity.
(25) Electric lighting.
(26) Telegraphy and telephones.
(27) Different applications of electricity.

There is a class (15) in group No. 3 devoted to "Instru-

ments of Precision, Coins, Medals," and one in group No. 6 (32) styled "Railroad and Tramway Construction," and that seems to complete the list of classes under which products representing electrical science and industry may be displayed. It seems strange that, although there is an "Electric Lighting" class, there is no distinct provision for electric railway apparatus. The classification is uneven and scanty and is not likely to find favor with electrical exhibitors. Classes 23 and 27 will be unduly loaded with exhibits, if the exposition is successful from an electrical point of view, and several other classes—such as "Electrical Heating and Cooking," "Devices and Methods for Current Transmission," "Pro-

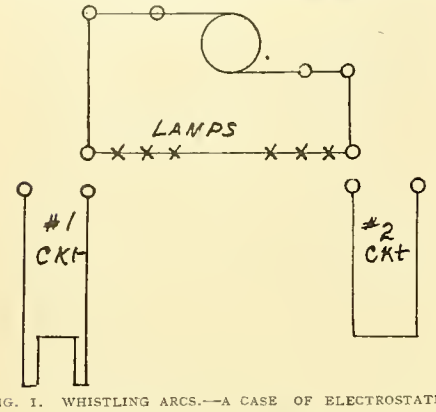


FIG. 1. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

duction and Application of the X-ray and Other Vacuum Tube Phenomena," and others that could be easily suggested—might be set off with advantage.

Protection of High-tension Lines from Atmospheric Electricity.

A report on this subject by Roger Chavannes, at the recent electrical congress, closed with the following conclusions:

First—Atmospheric discharges following a line of many conductors select one in preference, thence choosing the easiest route to earth.

Second—The easiest road for this discharge is one having a feeble ohmic resistance, a good earth contact and a minimum inductive resistance.

Third—All angles or curves are obstacles to such discharges; above all if successively they form a zig-zag or spiral.

Fourth—All machines, subterranean cables, apparatus, etc., should be protected by induction spools.

Fifth—Lightning arresters should be so constructed as to break the discharge spark.

Sixth—To prevent the discharge taking a second route along a conductor, at the time of rupturing the spark, the lines at that point should be well separated.

Seventh—Fusible metals on the ground lines of arresters are to be avoided, unless where a constant inspection is rigidly enforced.

Eighth—It is best that each arrester should have a separate ground connection.

Ninth—In protecting subterranean cables, each conductor should have at least two arresters. These are to be placed near the induction coils, these supplementaries being of fixed points, with earth contacts furnished with multiple cut-outs.

Tenth—For alternate currents the best lightning arrester consists of an earth contact through water.

Eleventh—These suggestions are in general only applicable to inductive discharges. Protection against lighting proper requires that the posts be protected by ordinary lightning rods, or something similar.

Twelfth.—In lighting by alternate and transformer currents the secondary circuits may become a source of extreme danger through a break in the internal insulation. This danger may be effectually avoided by grounding one pole of the secondary circuit.

The last suggestion furnished the occasion for a free-for-all discussion on the mooted question of grounding the secondary lines. While this plan had many advocates from the viewpoint of personal safety, it was pointed out on the other hand that it certainly could not but be objectionable, for in case of a breakdown of the transformer it would introduce a permanent ground on the circuit which furnishes the illuminating current for one or more consumers, and while it is true that this ground *per se* could do no harm, an accidental second ground, by diverting the current, might result disastrously.

In the United States Circuit Court at Boston on February 20th the petition of W. H. Baker, vice-president of the Postal Telegraph company, for a receiver for the United Telegram company was heard by Judge Colt. The petition claims fraud and conversion of the company's money for officers. Herman J. Pettinghill was appointed receiver of the United Telegram company, which is a New Jersey corporation, having a capitalization of $500,000.

Whistling Arcs.—A Case of Electrostatic Induction, and the Remedy.

By Forée Bain.

During last summer the writer had under supervision the installation of an electric arc light plant designed for lighting the West Chicago parks and boulevards. The plant has an ultimate capacity of 1,350 full arc lights, the present number installed being 816, included in six circuits of about 400,000 feet of lead-covered, underground rubber wire cables. The size of the conductor is a trifle larger than No. 5 B. & S. gauge. These cables are drawn into wooden pump log conduits placed in the grass plats along the boulevards and parks, about 12 inches below the surface. The lead cables are drawn into the poles in succession and are connected to the lamp switches in the pole base. From the switch wire of a similar character without lead covering extends to the lamp on the upper end of the pole. The pole is made in three sections, the lower base section of cast-iron and the middle section of a hollow wooden mast, while the upper iron section is a cast-iron socket around a goose neck of bent wrought-iron pipe, at the extreme end of which the lamp is attached by means of a lamp insulator.

Circuits No. 1 and No. 2 were the first that were completed and gave most of the trouble. Circuit No. 1 contains about 12 miles of cable and 116 Adams-Bagnall shunt arc lamps. Circuit No. 2 contains about seven miles of cable and 86 similar lamps. The district here referred to is designated in the diagram, Fig. 8, presented on page 132.

The strange phenomenon to which I refer was a loud, harsh, whistling noise produced in the lamps as soon as the arcs were struck. The whistle was nearly identical in tone to that of the deviline whistle of the familiar peanut roaster. It registered somewhere between upper

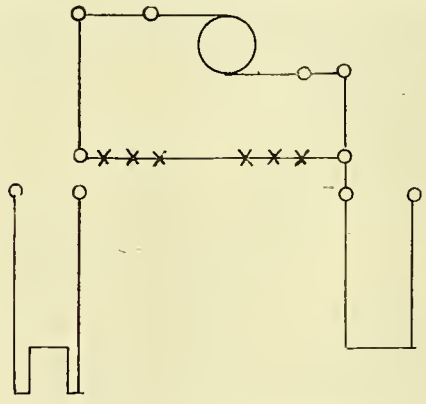


FIG. 2. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

and middle C. It was very loud and could be heard about two blocks distant from the lamp engaged in this disagreeable pastime.

The lamps did not all whistle at one time; it seemed to be produced in those having long arcs. As soon as the lamp would feed, the whistling would disappear until the arc became long again, or this effect may have produced long arcs. It was noticed that the whistling was always accompanied by a flaming arc.

Before I had recovered from my surprise at this combination of light and music the telephone and fire-alarm people were on the still hunt for the disturber of their peace. The telephone system of the entire west side of Chicago was rendered almost inoperative each day after 5 P. M. by this unusual induction. The noise in the telephone circuits was constant, and harsh as long as the plant was in operation, and rendered the use of this little instrument of communication an abomination. It was very much the worst case of induction in the experience of the Chicago Telephone company, and the management was naturally very anxious to find it and to remove the cause as quickly as possible. To their engineers, Mr. Abbott and Mr. Beatley, I am indebted for intelligent assistance; the latter gentleman recorded the result of the experiments and observations by agreement, and from these records I have freely made extracts. I am also indebted to Mr. Adams of the Adams-Bagnall company, L. E. Jones, my assistant, and others. The first thought suggested was that the impulses due to the sections in the commuator set up vibration in the circuit and that this caused the induction in the telephone circuit. This was proven fallacious by the use of different dynamos having commutators with a great difference in the number of segments. The Excelsior dynamo with 48 sections at a speed of 700 revolutions per minute would produce

$$\frac{48}{2} \times 700 = 16{,}800$$

impulses per minute. The Fuller-Wood dynamo with 175 sections at a speed of 900 revolutions per minute would produce

$$\frac{175}{2} \times 900 = 78{,}750$$

impulses. The tone in the lamps and in the telephone circuits was exactly the same pitch independent of the number of vibrations produced by the commutator of either dynamo. Had this been the producing cause the pitch would have been very decidedly changed. It was then thought that it might be a characteristic of the lamp; the armature being in motion might set up a counter electromotive force that would produce the effect in the arcs. It was found, however, on close examination that the armature of any given lamp was in a state of rest while its arc was whistling vigorously. It was thought that the infinitesimal motions of the armature of the lamp might produce vibration, but this was disproved by attaching two carbons over the top edge of a small pine box and separating them, when in circuit, by hand. The arc produced in this way could be made to whistle when the arc was lengthened and stop whistling when the arc was shortened.

Before the latter experiment was tried it was thought that probably the partially enclosed globe might be responsible, by holding the non-combustible gases which might in some way cause a vibration in the arc. The globe pans were opened so that the gases might drop out, without any change in result.

The dynamos of the station are driven by means of the American system of ropes, and the usual static effect produced when leather belts are used is not present. Ropes are used partly for this reason. However, the frames of the dynamos were first grounded through a lead-pencil mark about six inches long and afterward through Geissler tubes, without any appreciable effect. Up to this time the whistling sound had been continuous as long as one or more circuits were in operation. When two circuits were started the induction of the telephone lines seemed to increase in volume with a slight change in the pitch of the note, probably the resultant of the two different notes. There were nodes in the new note that seemed to bear some relation to the hum of the dynamos, but of a very much higher pitch than that which was produced by the commutators and brushes of the Excelsior dynamos.

The lead sheaths of the cables were now metallically connected together at a point where they enter the dynamo room, and they were also grounded at 25 different places along the line of the circuits by means of long iron rods driven deep into the bottom of the manhole. After this was done it was noticed that the whistling would disappear and reappear at periods varying in duration and irregular intervals. Frequently the telephone circuits would be quiet for an hour and then in periods of only a few moments at a time.

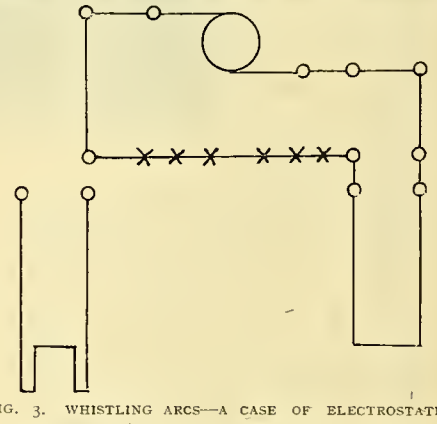


FIG. 3. WHISTLING ARCS—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

A telephone receiver and several hundred feet of wire were taken out on the circuits to make tests. The first test consisted in stringing a single circuit between two electric light poles in Garfield Park, using the lamp poles as grounds.

The cables in Garfield Park are fiber cables that were put in about three years ago. The greater number of lamps on this circuit are of the Fuller-Wood double carbon type, and they were operated from the same dynamos as the other circuits.

No induction from this electric light circuit was

noticed in this test, although the exploring line used was placed parellel to and in as close proximity to the circuit as possible between the poles.

The next station for test was upon the south side of Washington boulevard, and about three lamps east of Homan avenue, on the new rubber cable circuits. The first consisted in a repetition of the conditions at Garfield park, the exploring wire being approximately 150 feet in length.

Gas lamp posts were also used for grounds, although it was found that there was no noticeable difference when gas and gas, gas and electric, or electric and electric posts were used for the test. This test showed a very perceptible induction in the exploring circuit of the same note and character as that noticed in the power house previously.

Then the exploring wire was stretched across the street at right angles to the circuits, grounds being obtained on either side through the gas and electric light poles. Induction was still very heavy, though probably not so much as in the former test. The exploring wire was moved to an angle of about 45 degrees to the line of the cables, when the induction was about the same as before. These experiments were repeated by touching the wire to the ground at either end, and here the induction was perceptible, but not so pronounced. The next test consisted in opening the manholes diagonally across the street and upon opposite sides and connecting the sheaths of two cables of different circuits together through the telephone receiver. This test gave the same note, but so loud that it could be heard easily more than 100 feet away from the telephone. The telephone receiver was now taken out of circuit and the two lead sheaths were metallically connected together with the copper wire. It was noticed that when using the receiver without any wires being connected to it,

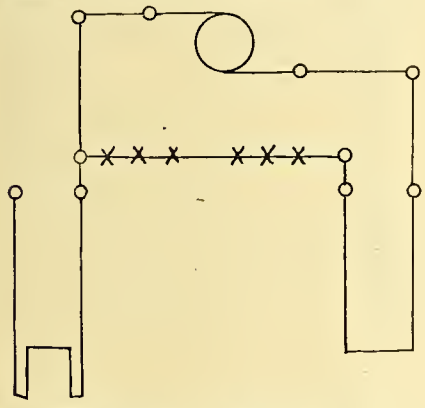


FIG. 4. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

and when the observer was stationed in the middle of the street, the induction was decreased when the metallic connection was made and louder when the connection was broken. Opening and closing was readily detected by the telephone. When the observer was outside of the area enclosed between the two circuits this opening and closing of metallic connection between the sheaths made no perceptible difference.

Tests were now made in the vicinity of the cables with a receiver not connected in any way. This test showed that invariably when the axis of the telephone magnet was parallel to the plane of rotation of the lines of magnetic force and at right angles to the axis of the conductor, the induction was at its maximum when in comparatively close proximity to the cables, say 10 feet. The inductive effect on the telephone receiver was entirely neutralized when the magnet was either parallel to the plane of rotation of the lines of magnetic force and normal to the axis of the conductor, or normal to the plane of rotation of the lines of magnetic force and parallel to the axis of the conductor.

After these tests were made the writer became convinced that the trouble was caused by electrostatic induction, and it immediately occurred to him to join together the entire system of lead sheaths metallically wherever they had been severed, as when entering a pole, and this would have been done immediately but for the fact that nearly every foot of the lead sheaths was grounded by being in contact with damp tubes. They were virtually, it was thought, connected together, and, therefore, the idea of doing this was abandoned.

A great number of other tests were made using condensers, Leyden jars, exploring coils, Geissler and Crookes tubes. An electrostatic voltmeter was used in measuring the potential of the circuits; several comparatively short pieces of cable, probably several hundred feet in length, used to connect the dynamos to the switchboard, were connected together by attaching a wire to the sheaths of each piece and joining these together. The potential between these lead sheaths and ground was found to be 250 volts, something more than a volt per foot. At this discovery it was thought by several of the observers that it was leak and not induction. To determine this point a 220 volt 16 candle power incandes-

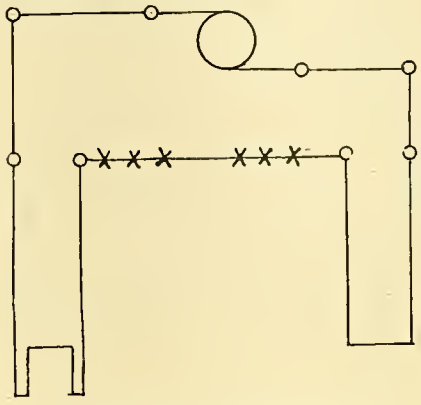


FIG. 5. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

cent lamp was connected in between the sheaths and ground, and the filament turned a bright red. If it had been a leak the lamp would probably have glowed above normal candle power. A 16 candle power 110 volt lamp was substituted and the heating of the filament was just barely visible, indicating that the static capacity of the cable was exhausted with the flow of a very small current. When a telephone receiver was substituted for the lamp the whistle was very loud and could be heard all over the power house above the noise of the machinery.

Geissler tubes were then used. Circuit No. 1, which had evinced the most decided results, was selected. Several tubes were made and placed at intervals of about one mile apart on the circuit. These tubes were of a low exhaustion and were connected between the copper conductor and the lead sheaths. For about two hours after these tubes were placed in circuit, after the lamps were lighted, it was noticed that all induction ceased and the telephone circuits for the first time were unaffected. It was observed that some of the tubes were discharging and illuminating the entire interior of the lamp poles in which they were placed, while several others seemed to be entirely inoperative. The result of this experiment was to have all of the tubes shattered after being in service less than three hours. Tubes of different sizes and of different degrees of exhaustion, from a Geissler to a Crookes, were tried, with the result that when the exhaustion was low enough to effect any change in the induction the tube would soon become destroyed, and when the exhaustion was high enough for durability its effect

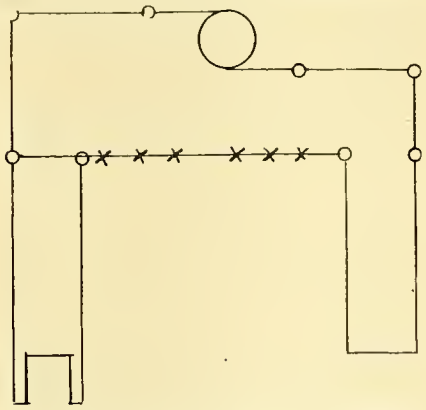


FIG. 6. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

to reduce the induction could not be noticed; therefore, the use of tubes was abandoned.

The next experiment consisted in connecting up 100 lamps in the station, arranged at the switchboard so that any desired combination of this lamp circuit with any of the external circuits could be made. All lamps upon circuits Nos. 1 and 2 had been cut out, leaving simply the ohmic resistance of the copper conductor in the circuit.

Fig. 1 illustrates the first test. This consists simply in starting 100 arcs in the station without any external connection. These lamps started off without trouble and no trouble was noticed on the telephone lines.

The second experiment, as shown by Fig. 2, consisted in legging on to one side of the lamp circuit in the station, one side of No. 2 circuit. With this arrangement no trouble was experienced in starting the lamps and no noise could be heard upon the telephone lines.

Fig. 3 shows the third experiment. This consisted simply in looping circuit No. 2 into the lamp circuit at the station. No trouble was experienced in starting the lamps and no noise resulted.

Experiment number 4, Fig. 4, consisted in legging on one side of circuit No. 1, as shown in the sketch, No. 2, circuit remaining exactly the same as in test No. three. With this arrangement the old trouble was noticed in starting the load. The machine flashed over a number of times. The circuit was finally started by cutting off the external circuits, and after the circuit was placed in operation these external circuits were plugged on as shown. A very troublesome note was immediately noticed upon the telephone system. This was practically the same in volume as had been noticed previously.

Test No. 5, Fig. 5, consisted in looping in both circuits Nos. 1 and 2, upon the lamp circuit at the station. The note was increased slightly in volume.

Test No. 6, Fig. 6, consisted simply in short-circuiting circuits 1 and 2, at the power station, leaving the closed loop so formed tapped upon each side of the machine. With this arrangement the volume of inductive trouble increased to the greatest degree that had ever been noticed. It was so bad that telephones absolutely could not be used and business was practically suspended on the telephone lines for about five minutes during which the test was in progress.

In test No. 7, Fig. 7, the connections were the same

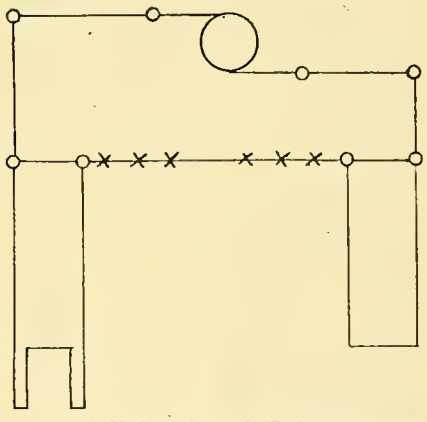


FIG. 7. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

as in the last test, with the exception that the jumper was taken off circuit No. 2, cutting the circuit in series. These are the only different combinations which were made with the circuits.

An interesting experiment performed in the station with conditions favorable for the inductive trouble was the drawing of an arc in a box between two plain carbon points. This arc was drawn and developed exactly the same singing that had been noticed in the lamps.

The experiment was also made between two pieces of copper wire. In the latter case the arc was particularly noisy. This, of course, indicates that the arc itself is one particular feature of the trouble. In all probability it would seem that it was caused by the whistling arc and the capacity of the underground cables.

It will be noticed in looking over the diagrams submitted herewith, that in no case was trouble noticed except where a difference of potential existed in the underground system. Where a test circuit was simply carried on one of the external circuits the difference in potential was very small, being only that due to the ohmic drop in the conductor.

When one circuit was upon one side of the load, the other being upon the opposite, and the maximum difference of potential existing, the note was increased in volume, as would be expected.

Putting the jumpers upon the circuits, as in experiment No. 6, simply raises the potential upon all points of the circuit to the maximum, and the resulting very loud note is what would be expected.

In making an experiment in the station of drawing the arc by hand, it was noticed that the pitch of the note remained unchanged for variations in the length of the arc. This would indicate that the capacity of the cable is the ruling factor which governs the pitch. Whistling

was, of course, noticed in the arcs upon the test circuit in the station. The whistling seemed to travel from point to point upon the circuit, there being approximately one-third of the lamps singing at the same time. It would seem that when a lamp or set of lamps fed, thereby shortening their arcs, the note was immediately taken up by another lamp, or other lamps.

As a result of these experiments it was decided to interconnect, as far as possible, the sheaths of the underground cable, the idea being that thereby the difference of potential which had necessarily existed in different pieces of the sheath would then be decreased. Jumpers were put on between the sheaths of the two pieces of cable entering each manhole. In addition a jumper was put from sheath to sheath on the north and south sides of Washington boulevard and Jackson boulevard, upon the east side of Ashland avenue. These latter practically short-circuited the loops upon Washington boulevard and Jackson boulevard east of Ashland avenue.

A jumper was also put between the sheath of No. 1 circuit on the north side of Washington boulevard and the west side of Ashland avenue; to the sheath of circuit No. 2 upon the south side of Washington boulevard and west side of Ashland avenue; also another jumper from the sheath of circuit No. 2 on the north side of Jackson boulevard and the west side of Ashland avenue to the sheath of circuit No. 1 on the south side of Jackson boulevard and west side of Ashland avenue. These jumpers were placed in service rather hurriedly and probably not as perfect workmanship was put upon them as though more time had been allowed. The result, however, of the test was extremely satisfactory. Induction was practically removed, but as a very faint trace remained and as it was supposed that improved connections and the consequent decrease in resistance would further remedy the trouble, this was tried and proved to be true. The jumpers were securely soldered together, and now that the plant is operating at nearly its full capacity there is absolutely no noise observed in the lamps or on the telephone system.

A very peculiar phenomenon was observed when a very great difference of potential was impressed between two circuits, that is that the static charge would short-circuit over the commutator of the dynamo and cause it to "spill over" before it could "pick up" to more than six amperes, and when a circuit was attached to both poles of the dynamo feeding 100 lamps in the station, this effect was so pronounced as to render it impossible to start the lamps until the circuits had been first entirely cut loose from the lamp circuit and afterward plugged in when the dynamo had picked the lamps up.

The foregoing experiments and observations seem to lead to the following conclusions:

The phenomenon is entirely independent of the type of dynamo or lamp used.

It is the characteristic of a cable having a high dielectric and large static capacity.

It is to a very great degree independent of the insulation resistance of the circuit to ground as a whole.

The pitch or note produced is determined by the average length of the lead sections left unconnected in a given circuit.

Atmospheric conditions do not in the least affect it. The whistling was as noticable and pronounced on the dampest night as when the thermometer indicated 20 degrees below zero.

The effect of metallically connecting all the lead sheaths together neutralizes or removes the static charge. There was no perceptible static charge left in the cable after the current from the dynamos ceased to flow.

That the reason the flashing of a dynamo carrying high voltage does not effect to pierce a cable is because self-induction and static induction never allow the potential to rise above the initial, and, therefore, inherently the cables protect themselves.

The only difference in the installation of these circuits and that of usual practice is that in these circuits the cables from the manholes to the lamp poles pass through separate ducts, for convenience, and the lead sheaths do not come into intimate metallic contact. In most other cases they are brought into metallic contact by being brought together in the same duct.

The static effect seemed to decrease the power factor of the dynamos without altering their operating efficiency. However, this was not accurately determined.

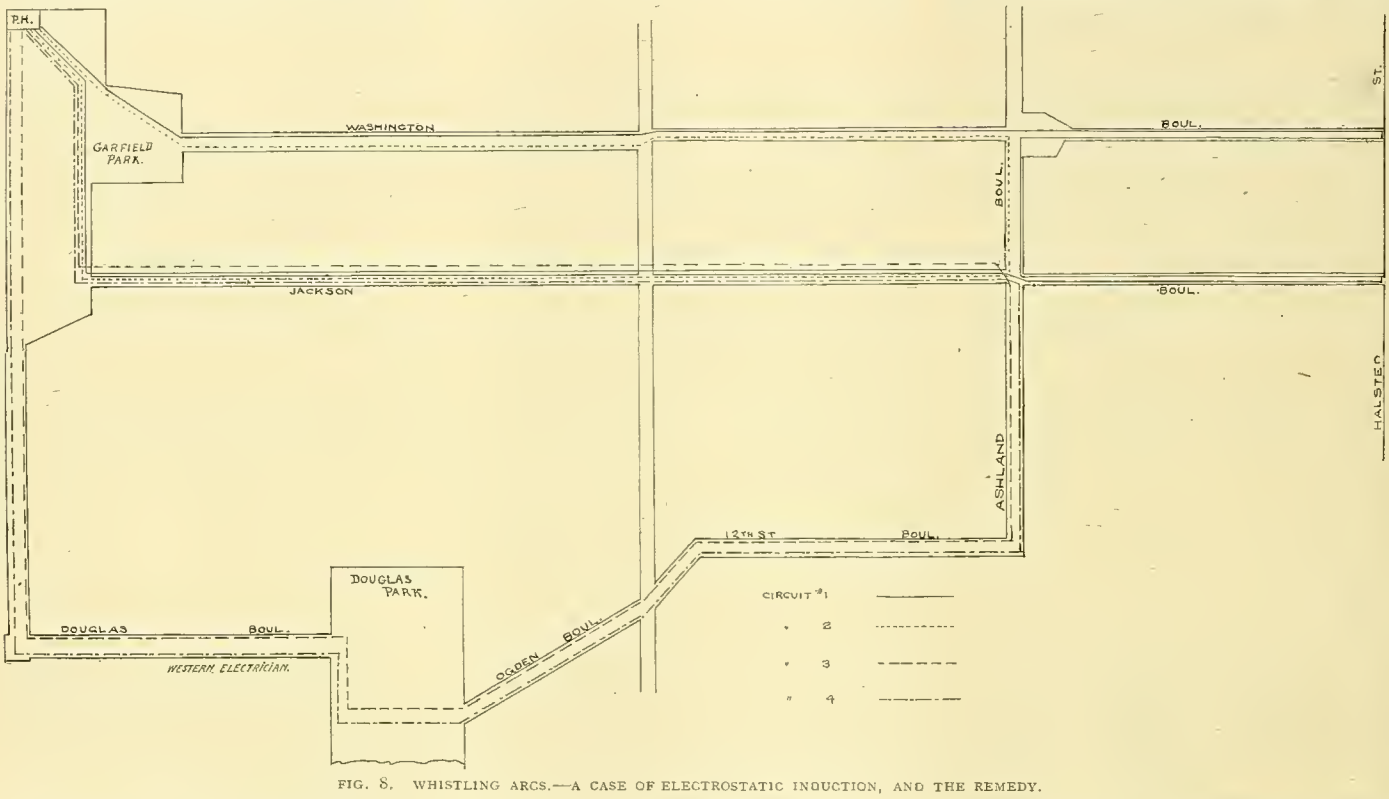


FIG. 8. WHISTLING ARCS.—A CASE OF ELECTROSTATIC INDUCTION, AND THE REMEDY.

Gradual Improvement in Business Noted.

Conservative men agree that there is a gradual improvement in the condition of trade. In Dun's "Weekly Review of Trade" last week the following paragraph appeared:

Genuine improvement in business does not come with a rush, like the breaking of a great dam. The growth for some weeks past has been more encouraging, because in nearly all lines it has been gradual and moderate. The rupture of the steel-rail and other combinations in the iron business has brought out a vast quantity of trade which had been held back and has set many thousand men at work, while the slow but steady gain in other great industries has given employment to many thousands more, but the full effects will not appear until increased purchases by all these swell the distribution of goods. Meanwhile it is substantial ground for confidence that months which are regarded by many in the money market with serious apprehensions have passed without disturbance and with steady gain in the position of the country and of the treasury.

Washington, Ia., has contracted with the Washington Illuminating company for 35 arc lights, to burn until midnight, for $35 per lamp per year.

Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them.[1]

By John W. Howell.

The first part of this paper, which relates to the conductivity of carbon filaments, is in the nature of a discussion of a paper read before the Institute by Prof. Anthony, at the May meeting in 1887. Prof. Anthony spoke of a change from negative to positive of the temperature coefficient of some carbon filaments which he had observed. He illustrated the change by a figure, which I will reproduce here for reference, Fig. 1. Prof. Anthony stated that this change did not occur in all filaments, and that he was unable to explain the circumstances under which it did occur.

Prof. Elihu Thomson, in his discussion of Prof. Anthony's paper, said that he had observed the same phenomenon, but had not investigated it sufficiently to explain its cause.

About four years ago an inventor offered to the General Electric company a method of coating carbon filaments with metal, claiming thereby a very great improvement in the performance of the filaments. The metallic coating was applied by heating the filament to high incandescence in the presence of the vapor which was obtained from a very thick dark-colored liquid, the application being made by the same means as is employed in the ordinary hydrocarbon flashing process. The proof which he gave that his filaments had a metallic coating was the fact that the resistance of these filaments was lower at about red heat than it was at higher temperatures.

In order to test his assertions, I treated a number of filaments with his dark liquid, and, for a comparison, treated in exactly a similar manner a number of similar filaments, using ordinary gasoline. To the surprise of both of us, the gasoline filaments showed the same rise in resistance, after passing the dull red temperature, as was shown by the filaments supposed to have a metal coating. This fact led me to investigate this phenomenon.

I had previously made resistance curves of a great many Edison lamps, which had filaments made without hydrocarbon flashing, and I knew that the filaments of all these lamps continued to fall in resistance to the highest temperature which they would stand. As we had very recently adopted the hydrocarbon treatment upon our filaments, I associated the change in the resistance curve with treated filaments. The filaments which I have previously described as having the reverse curve, were quite heavily treated. I now made a set of 10 lamps with various amounts of treatment, all made from similar base filaments. These lamps had filaments the resistance of which, when cold, were 90, 80, 70, 60, 50, 40, 30, 20 and 10 per cent. of the cold resistance of the original base.

I found upon plotting the curves of these filaments (Fig. 2) that the untreated filament fell in resistance as it was made hotter, and that this fall continued to the highest temperature at which I dared run it.

The slightly treated filament fell in resistance more rapidly than the untreated filament at first, and less rapidly as the high temperatures were reached, its curve finally rising above that of the untreated filament. As the

1. Read before the American Institute of Electrical Engineers, New York, February 17, and Chicago, February 24, 1897.

amount of treatment is increased, the curve falls more and more rapidly at first, and less rapidly at the higher temperatures. When we reach the filament treated to 50 per cent., we find that it falls rapidly to about 50 per cent. of its cold resistance, and remains practically constant at higher temperatures. The curves of filaments treated to less than 50 per cent. all rise after reaching their lowest point, which is reached at about 50 per cent. of their three watts per candle voltage.

These curves show the changes in resistance of these filaments. The ordinates are percentages of the cold resistances of the various filaments, so that all curves start from the 100 per cent. mark. The abscissæ are percentages of the voltages at which the various lamps take three watts per candle. The bottom curve on this sheet illustrates the resistance curve of a carbon filament which had been treated to about one per cent. of its original resistance. This made a filament which was nearly all treatment. This curve shows an increase in resistance from its lowest point to the last point obtained of about 25 per cent.

This lamp was measured at the Edison laboratory by Mr. Kennelly and myself. The readings were very carefully taken upon very sensitive instruments, and there can be no doubt as to the accuracy of the curve, as it agreed very well with the measurements I had previously made upon the same filaments. These curves can be obtained a good many times from the same filaments, so there is no permanent change in the filaments which in any way accounts for the rise in resistance. The cold resistance of the filaments, after being measured, were found to be the same as before any measurements were made.

These same 10 carbons were taken from the lamps and put into a baking oven, the temperature of which could be regulated very nicely by an electric heater. These filaments were heated to about 500 degrees Fahrenheit, the temperature being measured by two mercury thermometers. The resistance curves obtained

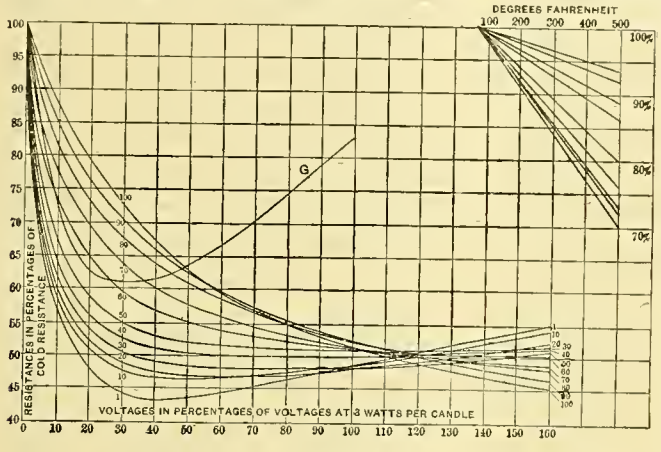


Fig. 2. Curves showing changes of Resistances of Lamp Filaments with Voltage and Temperature.

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

in this way are shown on the upper part of the sheet, and agree quite well in character with the resistance curves obtained by measuring the volts and amperes of the lamps, so there is no doubt that the changes in resistance are due to temperature, and to nothing else.

I then obtained untreated base filaments from as many kinds of amorphous carbon as I could obtain, and plotted their resistance curves. I tried filaments made of bamboo, silk, cotton, cellulose (made by the ordinary squirt process), tamadine and paper All of these base carbons gave the same curve, and all of them continued to fall in resistance as long as I was able safely to increase the temperature,

These carbons were quite different in their physical characteristics. The silk filaments were the most porous, and had the roughest and the best heat radiating surface, while the tamadine filaments were very dense and had a very highly lustrous surface.

I was entirely unable for a long time, after making these curves, to come to a satisfactory theory regarding them. The reverse curve is not caused by changes in the characters of the surfaces of the carbons, due to emissivity, because no corresponding changes in emissivity occur.

I made observations upon untreated and heavily treated filaments, to see if they acted differently in regard to their expansion with heat, thinking that possibly the changes in the resistance curve may have been caused by a change in the expansion curve with temperature. These observations were not very refined, being simply observations made by means of a telescope, but they showed clearly that all of the carbons expanded with heat, and apparently there was no difference in this respect

It has been the custom for some time to speak of the carbon which is obtained by the treating process as graphite carbon, and knowing that Mr. Edison had, in 1881, made some filaments of graphite, by pressing the pure graphite, under very great pressure, into the form of loops, I was very anxious to obtain a lamp containing one of these filaments, to see whether it would have the same resistance curve as the other forms of untreated carbon. I have very recently obtained one of these lamps from Prof. Barker, of the University of Pennsylvania, and upon plotting its resistance curve I was very much pleased to find that it had the same characteristics as the heavily treated filament. It reached its minimum resistance at a dull red heat, and from this point as the temperature was increased, the resistance increased also. This curve is marked G upon the sheet on which the other curves are plotted.

It will be observed that the resistance curve of this filament does not fall as much as the other curves, and rises much more. This may be due to the different natures of the two kinds of graphite, or to structural differences. The top of the loop of the graphite filament got much hotter than the rest of it; this would cause this part to start rising before the rest had ceased falling in resistance, and this may account to some extent for the less total fall in resistance of this filament. The resistance of this filament, after the measurements had been made, was just the same as before they were made. This indicates quite clearly that our calling the treated carbon "graphitic" is correct, and that the change in the resistance curve of treated filaments is due to the graphitic nature of the layer of carbon which is put on during the treating process. The graphite filament lamp referred to is shown in Fig. 3.

The second part of this paper, which relates to the conductivity of the vacuous space surrounding incandescent filaments, may be considered as a discussion of the paper upon the Edison effect in incandescent lamps, which was read before the Institute by Professor Houston in October, 1884, and which was the first paper read before this society.

Edison effect is the name given to the effect produced by those currents, first observed by Mr. Edison, which pass from one leg of an incandescent filament across the vacuous space to the other leg, and which can be observed by connecting a galvanometer between the positive lamp terminal and a wire sealed into the bulb and projecting into the vacuous space.

Fig. 4, which is taken from Professor Houston's paper, serves to illustrate Mr. Edison's original experi-

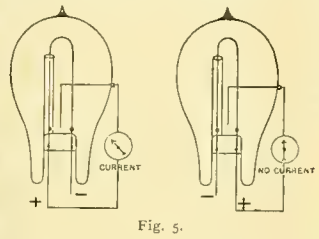


Fig. 5.

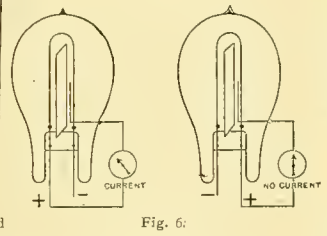


Fig. 6.

ment. The galvanometer indicates a current flowing from the positive lamp terminal through the galvanometer and third lamp wire, and through the vacuous space to the negative leg of the incandescent filament. If the external connection of the galvanometer be changed from the positive terminal to the negative terminal, no current will flow through the galvanometer. This effect can be observed in the most highly exhausted lamps. A lamp so highly exhausted that it shows no glow when tested with an induction coil, giving a spark ¾ inch long, will allow a current sufficiently large to show plainly on a not very sensitive galvanometer, to pass through its vacuous space. This current increases as the temperature of the filament is increased, but in a well exhausted lamp is never greater than a very few milliamperes, when the lamp is burned at about 2½ watts per candle.

In 1884 Mr. Preece secured from Mr. Edison some lamps having wires sealed into the bulbs, and read a paper before the Royal Society describing some experiments made upon them, illustrating the Edison effect.

Prof. Fleming read a most elaborate paper before the Physical Society of London, in March, 1896, upon this same subject. Prof. Fleming's experiments proved that in well exhausted lamps the vacuum is not a conductor in the ordinary sense of the word, and that the current which passes through it is carried by negatively charged molecules, which pass constantly from the negative leg of the incandescent filament to the positive leg and to any inserted wire, thus bringing the inserted wire to the same potential as the negative leg. Professor Fleming also proved that these molecules pass in straight lines, and that their passage is completely or almost completely stopped by a glass or mica screen placed between the negative leg and the inserted wire. The following experiments serve to illustrate these effects:

Fig. 5 shows a lamp having a glass tube surrounding one leg of the filament, and a wire sealed in the side of the bulb, which projects into the center of the vacuous space. When the leg of the filament which is in the glass tube is made positive, and the filament heated to about a 2½ watt per candle temperature, the galvanometer, which is connected between the wire and the positive lamp terminal, shows a strong deflection, but when the leg in the tube is made negative the galvanometer, being as before connected between the wire and the positive lamp terminal, shows no deflection.

Fig. 6 shows a lamp having a platinum plate 2¾ inches long and ¾ inch wide between the legs of the filaments, and a wire inserted in the vacuous space. I also used lamps having a similar plate made of glass, similarly placed. In both of these lamps, when the vacuum was high, no current was produced between the wire and the positive terminal when the wire was shielded from the negative leg; but shielding the wire from the positive leg made no hindrance to the passage of the current. The facts

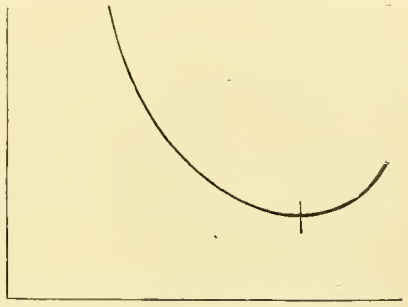


FIG. 1. CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

that no current flows when the galvanometer is connected between the negative terminal of the lamp and the inserted wire, and that a shield between the positive leg and the inserted wire has no effect upon the current, show that positively charged molecules are not emitted by the positive leg, while the screen effects just described show that the negatively charged molecules pass in straight lines.

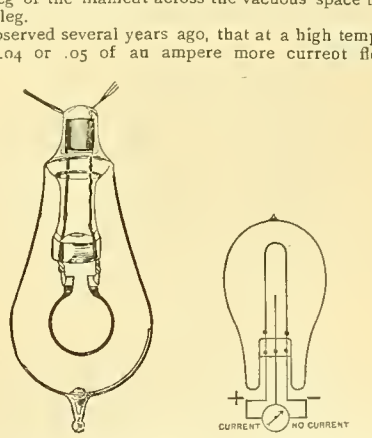
The facts, then, are these: The galvanometer indicates a current flowing, as we designate the direction of currents, from the wire to the negative leg, while experiments prove that the charged molecules which carry the current actually pass from the negative leg to the wire. These facts are entirely in accord with the results obtained by Crookes and others in their investigations of currents in high vacua.

If an alternating current is used to render the filament incandescent, the galvanometer will indicate a current with the connection made to either lamp terminal, because both are equally positive. The current thus produced is a unidirectional one in the galvanometer, and illustrates very well the unilateral conductivity between the incandescent filament and the wire.

Mr. Preece states in his paper that lamps which show a blue glow in the vacuous space give stronger Edison effects than those which do not show it. Prof. Fleming also observes that poorly exhausted lamps give slightly greater effects, but neither of them paid much attention to these lamps.

The blue glow in lamps has long been associated in my mind with a condition of the vacuum which makes it a conductor. Lamps in the process of exhaustion, just before the vacuum is perfected, show this blue very plainly, if a little more than normal current is sent through the filament. The blue increases as the current is increased and becomes very dense at very high temperatures. This blue indicates a current passing from one leg of the filament across the vacuous space to the other leg.

I observed several years ago, that at a high temperature .04 or .05 of an ampere more current flowed



FIGS. 3 AND 4. CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

through a lamp showing a good blue than through the same lamp, at the same voltage, when the blue had disappeared. I concluded that this extra current flowed through the vacuous space between the legs of the filament.

If a direct current about 20 or 30 per cent. greater than the normal current be passed through a lamp filament when the vacuous space shows a blue glow, the positive joint between the filament and the platinum wire gets red hot, while the negative joint remains cool.

I have always considered this as proof that the resistance to the passage of a current through a vacuous space was chiefly at the surface of the positive electrode, as

[*Continued on page 135.*]

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WORK on the Erie canal will be hurried just as quickly as the appropriation is placed at the disposal of the canal authorities. In the meantime there is plenty of work to be done in perfecting a system of electric towing to be utilized on the improved waterway. Capitalists stand ready to take advantage of the change, and one combination, headed by Erastus Wiman, is already planning to control this traffic.

UNSOLICITED testimonials are being received from men who were formerly opposed to the use of electricity for traction purposes, but who have been convinced by practical experience of the economy and efficiency of the new system. It is announced that the Brooklyn bridge trustees are thoroughly satisfied with the excellent service of the motors on the bridge cars, and, moreover, they have learned that a saving has been effected of $10,000 per year by the substitution of electricity for steam.

ONCE more announcement is made by the General Electric Railway company that it will begin construction work in March, and that the people of Chicago will soon have an opportunity to patronize the lines of a new South Side company. There are still some incredulous people in this community who affect to believe that the proposed road will not be built, or that in event of its construction it will pass into the hands of the Chicago City Railway company. Officers of both concerns disclaim any knowledge of a deal of this kind, in spite of persistent rumors to this effect.

NO MORE attractive subject for scientific investigation is under consideration to-day than the development of "Electricity from Carbon Without Heat." At present, as Mr. Case said in presenting his paper on this subject before the New York Electrical society, the experiments do not warrant anticipating immediate results of commercial value. "The chemicals used are too expensive for general use," he explained. "My endeavor has been to show that we can transform the potential energy of the carbon into electricity without waste. There are many agents which can be used, and, with experiment, will come the discovery of some agent cheap enough for general use. Then the solution of the problem given here will be practically applied and steam will become a thing of the past. At present we have only crossed the boundary line. Ahead lie tremendous possibilities."

Those who have devoted much thought to this subject realize the great difficulties that must be overcome before a solution of the problem is reached. The results noted in Mr. Case's paper, which is begun in this issue, are those of scientific investigation and not of commercial application, although it is hoped that they will lead to the latter much more speedily than Mr. Case and his associates seem to think.

REPEATED warnings to managers of electric railways not to operate trolley cars at high speed, unless reliable brakes were provided when electricity was substituted for horses as a motive power, have passed unheeded, and now an object lesson is furnished in the experience of an electric line in a Chicago suburb. An electric car going at full speed collided with a railway train, also going at full speed. As a result three persons are dead, one fatally injured and several others badly hurt. The gates were closed and the accident was caused by a motor car of the Calumet Electric Street Railway company becoming unmanageable, bursting through the guards and rushing upon the track in front of the express train. It is said that this same motor performed the same trick at the same place a few days before, happily without fatality at that time. The officials of the company deny this, and say that it was another motor which gave the first performance, but this does not improve matters, as it shows that the company had two unmanageable motors instead of one and kept them running over this dangerous crossing. It is not necessary to enter into a discussion of the dispute over responsibility for this deplorable accident. It is enough to know that the car in question, like most of those operated on the electric roads of Chicago, was not equipped with reliable brakes and therefore should not have been in service.

ELECTRIC and steam railways in Massachusetts are not on the same footing, in more ways than one. In an action growing out of an accident where a driver was run down by an electric car, there was a request made that the jury be instructed that if the plaintiff had an unobstructed view of the approaching car, and there was nothing to prevent him from turning off the track, the motorman on the car had a right to assume that he would seasonably turn off the track to avoid accident. This, the Supreme Court of Massachusetts supposes, was intended to embody a statement of the rights of electric cars irrespective of practice, and to put street railways on very nearly the footing of steam railroads. But whatever may be the law as to the latter, the court, in its decision of the case of White against the Worcester Consolidated Street Railway company, says that there is a great difference between the two cases. Electric cars are far more easily manageable and more quickly stopped than trains upon steam railroads. Their tracks are in the highway, where all vehicles have a right not merely to cross but to travel. So it holds the instruction was properly refused. Continuing its discussion of the subject, it says that in view of the inability of the cars to leave their tracks, it is the duty of free vehicles not to obstruct them unnecessarily, and to turn to one side when they meet them; but, subject to that, and to the respective powers of the two, a car and wagon owe reciprocal duties to use reasonable care on each side to avoid a collision. Neither has a right to assume that the other will keep out of the way at its peril, although the electric car has the right to demand that the wagon shall not obstruct it by unreasonable delay upon the track. To further illustrate, the court specifically holds here that if the jury believed, as it might, that the driver of the wagon did not know of the close proximity of the car, and that the motorman did see the wagon, and saw that the former was proceeding in the ordinary way around an obstacle, a standing vehicle, by driving from the right side of the road onto the street railway track, and clearing the track with reasonable speed, which he would naturally do, or might be expected to do, by returning to the same side of the street, it might well find that due care required the motorman to move slowly, or stop, until the wagon was out of the way. It would be well for street railway companies to impress this lesson on motormen.

AN amendment to the pending navy appropriation bill was introduced in the United States Senate last week by Mr. Lodge, providing for the expenditure of $25,000 to defray the expense of a survey of a route for a Pacific cable between Hawaii and Japan. This measure is supplementary to the bills already introduced providing for the construction of a cable between this country and Hawaii. The route for the first portion of this work has already been determined, the surveys of the Tuscarora, the Albatross and the Thetis furnishing sufficient data for the proposed cable to Honolulu. The necessity of the survey between Hawaii and Japan is realized by all who are familiar with the work already done in the Pacific. The first survey of which there is official record shows that deep depressions and lofty elevations exist between California and the Hawaiian Islands. Later investigation, especially the soundings of the Albatross and Thetis of recent years, furnished much valuable information which pointed conclusively to the practicability of the projected line to Hawaii. Enough is known of the condition of the bed of the Pacific to convince those interested in the proposed cable that a survey is required before any definite steps are taken to build the line beyond Hawaii. Advocates of the Pacific cable project have realized all along that the building of the line to Hawaii, while of great importance, especially to this government, was in reality only the first step in the great undertaking of securing direct communication with Asia. The commercial value of the project, coupled with the advantages which such a plan would give the government, commends the plan to thoughtful and patriotic Americans.

THE manner in which the people of Stockholm solved the problem of telephone service commands the thoughtful consideration of American communities. In Sweden as in this country, the pioneer work was done by the Bell company, but there, as here, the management persisted in exacting a rate for service that made it impossible for many who desired to participated in the benefits of the new enterprise to become subscribers. Accordingly little advancement was made while the Bell company enjoyed a monopoly, and the enterprising citizens of Stockholm soon came to the conclusion that very little benefit would be derived by the great mass of the people as long as this condition remained unchanged. Active competition was decided upon, and soon a new corporation was in the field. One of the inducements offered was greatly reduced rates of service. This brought forth the usual comment of the Bell company that the newcomers would soon be in a condition of insolvency. In this they were disappointed, for the new company not only lived and prospered, but it soon absorbed the Bell company's business in the Swedish capital. It is to-day doing a thriving business and it is furnishing the city of Stockholm the best telephone service in the world, according to competent critics.

Another lesson taught by the experience of the telephone movement in Stockholm is that a carefully conducted private enterprise has nothing to fear from competition with one controlled by the government. Outside the capital the telegraph department of the government owns and operates the principal telephone lines, and an attempt was made several years ago to get possession of the business in the chief city of the kingdom. Despite the advantages which the government had to offer in the way of direct connection with the numerous outside exchanges, etc., the private company not only retained its old constituency but secured a much larger number of new subscribers than the total number connected to the government lines.

The history of the telephone in Sweden should impress those who are interested in the development of the industry in this country. There is no good reason why the Bell company should control the situation, and if the anti-Bell interests pursue an intelligent and progressive policy the American Bell Telephone company, powerful as it is, will be compelled to yield to public demands.

Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them.

[*Continued from page 133.*]

the energy was chiefly developed there. If an alternating current is used, both joints get equally hot.

If a lamp be burned at normal incandescence with a direct current, when the vacuous space shows a good deal of this blue, the negative leg of the filament becomes coated with a carbon soot. This effect can be obtained in a few minutes if the blue is dense and the filament is run above a normal incandescence. This I have considered to be due to an electrolysis of a hydrocarbon gas in the lamp.

The lamps which show only a slight amount of this blue glow, if burned at normal incandescence, will not tirely this carbon soot perceptibly, and the blue will eo show disappear if the lamp is burned for a few hours. This blue is caused more by the character of the residual gas than by the degree of exhaustion. Lamps having a residual of bromine vapor do not show it at all, neither do they show any Edison effect. I have seen ordinary lamps ready to be sealed off the pumps which showed blue and then no blue, and blue again, at regular intervals of a few seconds. Such lamps show corresponding changes in the Edison effect.

If the current be gradually increased in a lamp which shows good blue, the positive joint will get hotter and hotter and finally its platinum wire will fuse. At this stage the resistance to the flow of current across the vacuous space is not great, and if the conditions are such that at this time all the resistance in circuit with the lamp has been cut out, so that the current flowing will be practically determined by the resistance of the lamp and the leads, enough current will flow through the vacuous space to fuse the platinum wires, which are sealed in the glass. This fusion is not due to the same cause as the fusion of the positive joint wire by the vacuum current, because it fuses both positive and negative wires, while the vacuum current fuses only the positive. This fusion of both wires is due to the fact that the low resistance of the vacuous space allows more current to pass than the platinum wire can carry. This is further demonstrated by the fact that a 10 ampere fuse in the circuit will often blow when this happens.

In order to measure the currents which pass from one leg of the filament to the other across the vacuous space, I measured the current at a given voltage of a number of lamps; first when the lamps showed a good dense blue, before they were well exhausted, and again after the same lamps were well exhausted and showed no blue. Some 55 volt 24 candle power lamps showed .4 of an ampere more on the first reading than on the second. All of this .4 of an ampere must have passed through the vacuous space, for the resistance of the filament remained practically unchanged or became a little lower during the operation.

I also measured the currents which passed across the vacuous space when these currents were large enough to fuse the joint wire, and also when they were large enough to fuse both platinum leading-in wires. I found that from one to five amperes passed across the vacuous space when the positive joint wire only was fused, and that when both wires leading through the glass was expanded so by the heat of the current that the glass was shattered, the current measured from 10 amperes to more than 25 amperes.

In order to measure the instantaneous current which shattered the glass, I raised the hand of the ammeter to successively higher points, to find the mark at which the current would just raise the pointer. I used an ammeter measuring 25 amperes, and when the pointer was raised to the 25 ampere mark the current through the vacuous space caused it to jump beyond this mark.

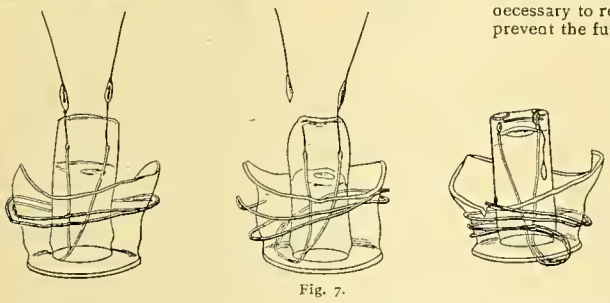


Fig. 7.

Figs. 7 and 8 show stems of lamps exhibiting the effects of currents of from one to 25 amperes passing through the wires and the vacuous space. The glass about the wires shows the fusing effect of the current, and the fracture of the glass shows the effect of the expansion of the wires by the heating effect of the current. The undisturbed condition of the glass between the two leading-in wires shows that the current did not pass across the glass, but must have passed through the vacuous space. Gradations of current from one to 25 amperes, used in this experiment, were obtained by regulating the amount of resistance in the circuit when the experiments were made. Unless some resistance had been left in the circuit, all of these lamps would have shown currents as high as 25 amperes or thereabouts, because the conductivity of the vacuous space increases very rapidly when the effect is great enough to start the fusion of the wires.

The lamp shown in Fig. 9 illustrates the fact that the heat produced at the positive joints by the Edison effect current is not simply the result of a mechanical bombardment. This lamp was exhausted to show a good blue. The temperature of the filament was raised sufficiently to cause vacuum currents large enough to heat the positive joint red hot. The outer end of the middle wire was then connected to the positive lamp terminal. When this was done the positive joint became cool and the middle wire got red hot. This was repeated several times. The middle wire got hot enough to fuse the end, which was platinum. This indicates that most of the heat is caused by the charged molecules coming in contact with some conductor which will carry away their charge. The current was not measured in this experiment.

Fig. 10 shows the lamp used in a similar experiment. The middle wire carried a copper plate about one inch long and one-quarter inch wide. This lamp was exhausted to show a good blue. An ammeter was connected between the middle wire and the positive lamp terminal. As the current was gradually raised the vacuum current heated the copper plate until it was fused, as shown in the figure. The ammeter in this case indicated over five amperes flowing through the vacuous space between the negative leg of the filament and the copper plate.

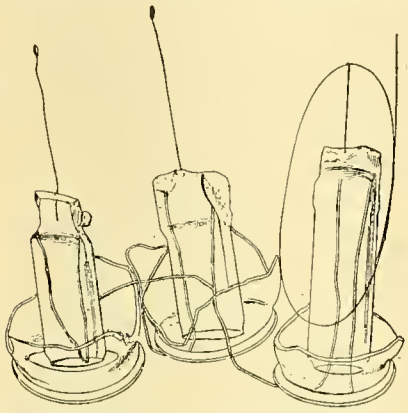


FIG. 8. CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

I next tried a series of experiments to determine whether the current which passes through the vacuous space when the blue glow is present was the effect of charged molecules moving in straight lines only, from the negative leg, or whether this current would pass around a screen. If a blue glow should appear in lamps with a shield between the legs of the incandescent filament it would be an indication that the charged molecules under these conditions could carry a current between the two legs in other than straight lines, and if the positive joint should get red hot in such a lamp it would indicate that the charged molecules pass around an obstacle quite freely. For this experiment I used a lamp with a glass plate 2¼ inches long and seven-eighths inch wide between the legs of the incandescent filament. It was necessary to raise the filament in this lamp to a very high temperature before the blue appeared, and then instead of appearing gradually, as it does in ordinary lamps, it appeared suddenly and in great abundance and the positive joint got red hot, so that it was necessary to reduce the temperature of the filament to prevent the fusion of the joint wire. As the temperature was reduced the blue gradually decreased, as it does in ordinary lamps.

When the temperature was so reduced that very little blue was visible the blue would increase gradually again if the temperature was increased. When the circuit was broken the filament had to be again raised to the high temperature before the blue again appeared. In this lamp the blue appeared at 136 volts, and remained when the pressure was reduced to 109 volts, but would disappear between 109 and 101 volts.

My next experiment was with a lamp (shown in Fig. 11) having a platinum screen between the legs of the filament and a platinum wire sealed in the side of the bulb and projecting in the vacuous space, with its end bent so as to run parallel with one leg of the filament for about one inch between the filament and the platinum plate. When this filament was heated to about a 2½ watts per candle temperature the vacuum current did not pass around the screen and no blue showed in the vacuous space. That leg of the filament being negative which was on the same side of the screen as the wire which was sealed into the bulb, I connected the galvanometer between this wire and the positive lamp terminal. The galvanometer showed a strong current. On breaking the galvanometer circuit blue appeared on the positive joint and in the bulb. I repeated this several times. It occurred when the temperature was considerably below the temperature necessary to start the blue around the screen.

In each case, connecting the galvanometer between the wire and the positive terminal would cause blue to appear about the inserted wire and the negative leg, and breaking the galvanometer circuit would cause blue to appear on the positive joint, and in the vacuous space about the positive joint, and about the negative leg of the filament.

With this same lamp I observed that when the filament was at a temperature not sufficient to start the blue, if I touched the positive terminal with one finger, and the inserted wire with the other, the blue immediately appeared in the vacuous space about the positive joint and the negative leg of the filament.

These experiments demonstrate that in lamps exhausted so as to show a good blue, the charged molecules have some difficulty in starting their passage from one leg to another around an obstacle, but maintain their passage after it has been once established. Also, that their passage around an obstacle is easily established by starting a flow of charged molecules from the negative leg through a small unobstructed part of vacuous space, to an inserted wire which is connected to the positive terminal, and then breaking the positive terminal connection.

To determine how large a current could be made to flow around an obstruction in lamps exhausted to show a good blue, I used a lamp shown in Fig. 12, having a glass tube about the negative leg, and the wire sealed in the side of the bulb, running parallel with the positive leg for about one inch. I connected an ammeter between the inserted wire and the positive lamp terminal, and raised the temperature of the filament until a dense blue appeared in the vacuous space and about the wire and the end of the glass tube. The temperature of the filament was raised until the vacuum current fused the platinum wire which was sealed into the bulb. When this occurred, the ammeter indicated 2¼ amperes, and remained at this reading one or two seconds.

Any of the lamps in which the condition of the vacuum is just right, showing the blue glow, will show a current in a galvanometer connected between the wire inserted in the vacuous space and the negative lamp terminal, but in all cases this current is small. One-half milliampere is the largest current I have observed under these conditions.

I next tried some experiments with lamps like the one shown in Fig. 13, which has two wires sealed in opposite sides of the bulb, which project inward to a point near the filament about ¼ inch above the joints. This lamp was exhausted to show a good blue. The galvanometer was connected between the wires which were sealed in opposite points of the bulb. No current was indicated until the temperature of the filament was raised quite high, and the blue glow was quite intense.

Under these conditions the galvanometer indicated a current of .1 milliampere.

I have made experiments upon two lamps containing bromine vapor. One of these lamps, which contained bromine enough to depress the barometric column one-twentieth inch, showed no Edison effect when the potential was run up as high as 170 volts, using a 110 volt lamp.

The second lamp had very much less bromine vapor in it, and showed a very slight Edison effect. This lamp acted very peculiarly. When first tried it gave an Edison effect which changed very little in value between 105 and 146 volts. At 120 volts the vacuum current showed a deflection of the galvanometer of 14 scale divisions, while at 128 volts it showed a deflection of only 12 scale divisions. I observed this several times. This was quite a large reverse change, as the current at 146 volts only increased enough to give a deflection of the galvanometer of 16 scale divisions. This change was observed on several days, but it was less marked each time it was tried, until it finally disappeared.

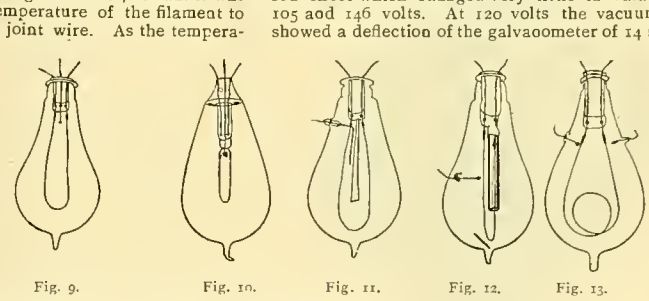


Fig. 9. Fig. 10. Fig. 11. Fig. 12. Fig. 13.

CONDUCTIVITY OF INCANDESCENT CARBON FILAMENTS AND OF THE SPACE SURROUNDING THEM.

The question naturally arises, what causes the blue glow in the vacuous space? The glow is luminous, and luminosity can only come from matter; consequently we conclude that the vacuous space, when blue shows, is filled with luminous molecules, and as these molecules are not of themselves luminous, we must seek for the cause of their luminosity.

We have seen that the negatively charged molecules liberate considerable energy on coming in contact with a body that conveys away their charge. We have also seen that when the blue glow is present there is a considerable flow of charged molecules through the vacuous space, and that the naturally rectilinear movements of these molecules are disturbed.

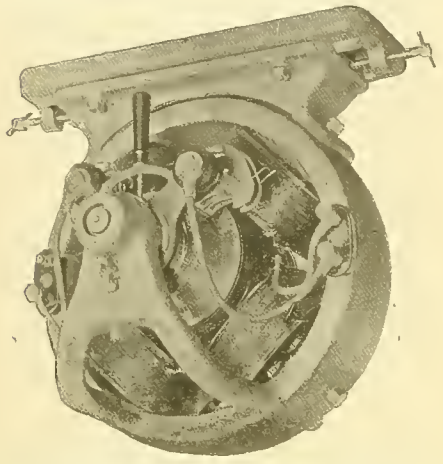
We also know that molecules are emitted from the positive leg about as plentifully as from the negative

leg, although these molecules do not carry a positive charge.

The conclusion seems to be that the blue glow is a manifestation of the energy developed by the meeting of the charged molecules with other molecules which take away part or all of their charge.

Well exhausted incandescent lamps which have burned a long time show a black deposit on the inner surface of the bulb. In lamps with thick, stiff, single-loop filaments, in which the two legs lie in the same plane, a light line may be observed in the black deposit, which is caused by the shielding of this line by one leg from the molecules emitted by the other leg. This line shows with about equal clearness opposite both legs, indicating that carbon molecules are constantly emitted from both legs, equally and in straight lines.

In lamps which have been imperfectly exhausted, the black deposit sometimes appears in patches, symmetrically placed with reference to the carbon. I regard these figured discolorations as indications of disturbances



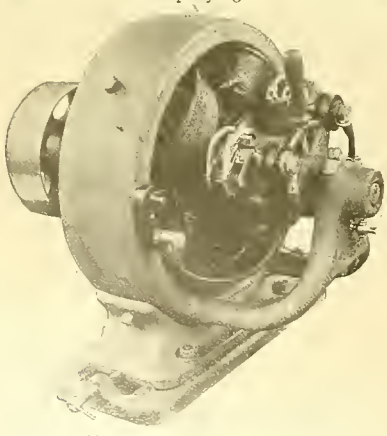
ADJUSTABLE BASE FOR DYNAMOS AND MOTORS.

in the rectilineal paths of the molecules, and of the influence of the magnetic field upon the disturbed molecules.

The activity of the molecules carrying current across the vacuous space seems to depend more on the temperature of the filament than on the potential difference between the legs, 40 volt lamps showing about as strong effects as 140 volt lamps. The energy they exhibit in one direction seems to be very much greater than we would expect from molecules actuated by a potential difference of only 40 or 50 volts. The action of these molecules in carrying electricity in one direction only may be an indication of the nature of the action between molecules in solid conductors carrying currents, rather than an illustration of the action of statically charged molecules.

Adjustable Base for Dynamos and Motors.

The special feature of the machines turned out by the Ahlm-Edwards Electric company of Medina, Ohio, is illustrated in the accompanying cuts. The company

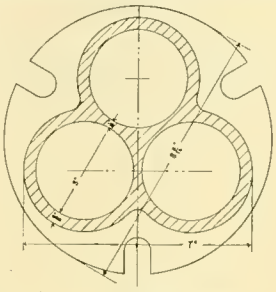


ADJUSTABLE BASE FOR DYNAMOS AND MOTORS.

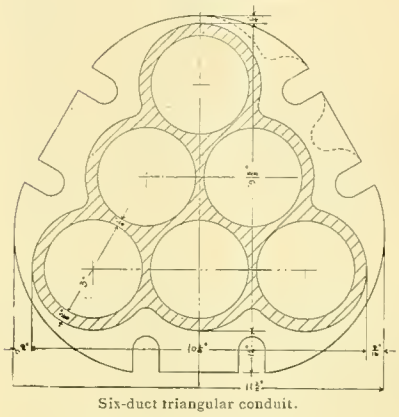
has placed on the market a type of motors that meets the requirements of customers employing small units. By use of the patented adjustable base, whereby the motor may be fastened to the wall or ceiling as well as to the floor, an undeniable saving in floor space is attained—a feature which must be fully appreciated by the power-consumer, as frequently the question of space proves to be of the greatest importance. For electrically driven machine tools such as boring machines, punches, lathes, etc.; for hoists, blowers, pumps, printing-presses and similar machines, these motors are especially adapted and have shown very flattering results in the severe tests to which they are subjected in practice and every-day work. For use in small isolated plants or private houses, the company manufactures a line of dynamos of moderate capacity which are designed with a special view of being driven from small steam, gas or gasoline engines. These plants have proved to be a commercial success wherever in operation, and the demand is rapidly increasing.

Cast-iron Conduits for Underground Cables.

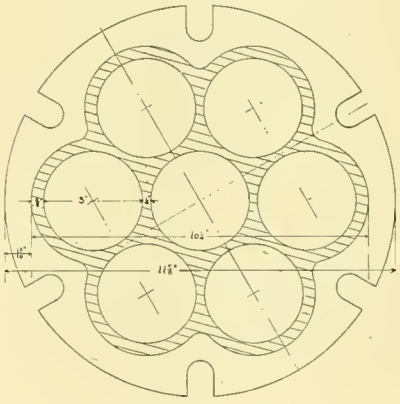
Considerable experimental work has been done in Chicago of late in the development of a cast-iron conduit for



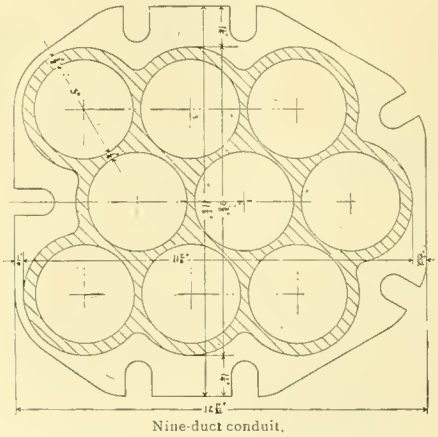
Three-duct triangular conduit.



Six-duct triangular conduit.



Seven-duct circular conduit.



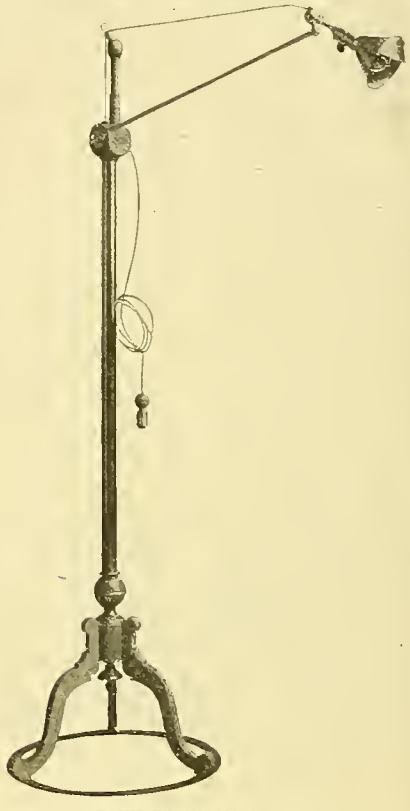
Nine-duct conduit.

CAST-IRON CONDUITS FOR UNDERGROUND CABLES.

underground cables, and the result of this investigation has been the production of a system including several sizes, designed by Forée Bain, and illustrated in the accompanying cuts. The ducts are circular in section and the inside surfaces are very smooth, an advantage gained by the manner of making the cores, and the use of a proper core mixture together with the coating of tar preparation. The cable sheaves are thus saved from brason in their passage through the ducts. The conduits are cast on end, the bottom on a chill plate and the top formed by a core; consequently the ends are always precisely alike, and the means provided for bringing the ducts in register are found to be effective.

As shown in the illustrations, these conduits are made of cast-iron in eight-foot lengths and contain three, six, seven or nine ducts, or any number which it may be found advantageous to include in one section. It is designed to have the walls of the least thickness practicable and the weight, therefore, reduced to a minimum. The adjacent lengths of conduit are connected through flanges by means of bolts. The opposite ends of each conduit are arranged with a projecting portion and a corresponding recess, which are designed to bring the ducts in perfect register, and also to serve in holding connecting conduits together while lying in position. The details of construction are clearly shown in the illustrations.

This style of construction has many features to commend it. The continuous length is self-supporting to some degree and the undermining by excavation or some other cause is not likely to have any effect. If, owing to any special conditions, increased strength is essential, provision can easily be made to meet the requirements. The projecting end of the conduit, fitting, as it does,



ESPERSEN SURGICAL LAMP.

into the socket on the adjacent length, is of some benefit in supporting the structure. The construction is such that the conduit is able to withstand any unusual pressures which may occur through the use of road rollers or similar cause, and it will resist the blows of a pick where a tile would be damaged. Through the compact arrangement of ducts this conduit is very economical of space. The flanges are designed with special reference to ease of handling on the surface, where they may be rolled about, and the weight is not so great but that several men with ropes could lower the heaviest of these conduits into the trench. The weight is approximately 10 pounds per duct foot. The necessary labor is reduced to a minimum, and this is a considerable saving in comparison with the cost of tiling with concrete bottom and cement filling.

The selection of cast-iron as the material best adapted to this purpose was made after careful study of the conditions to be met in actual practice and in view of the experience of other makers of conduits. The corosive action on cast-iron, which is only slowly disintegrated, is favorable to its use, rather than to the use of wrought-iron, which laminates and is more more quickly destroyed. Attention is also directed to the fact that it is an electrical conductor and therefore capable of carrying stray currents from electric railway or other circuits. The area of cross-section being comparatively large, a great volume of current will be accommodated, and the electrolysis of cable sheaths will be prevented. In the event of the conduit following a

ground wire the two may be connected so as to avoid electrolysis.

This form of conduit is manufactured by the Whiting Foundry Equipment company of Chicago, and it has thus far given excellent results.

Espersen Surgical Lamp.

The cut on page 136 shows an arrangement designed for the Pacific Electric company of La Crosse, Wis., which is meeting with favor wherever it has been introduced. It is contended that physicians and surgeons can find nothing better than this lamp for use in all kinds of examinations, and, it is said, at the operating table it has no equal. The standard is 59 inches high and has a swinging arm which allows the reflector to be placed in any position or angle. Many physicians and surgeons who are now using this lamp claim that it is the most practical device they have ever seen.

Some Recent Developments in Copper Manufacture.

By Harold P. Brown.

In these days of keen business competition, makers of electrical apparatus and machinery are quick to seize upon each advance in the arts which will reduce the cost of material or increase the daily output of their shops. And the alert engineers in our large electric power houses are always ready to adopt improvements which will effect a saving of power. Both of these classes will, therefore, be glad to learn of a discovery in metal handling which will reduce cost and save time and power. It has been considered impossible to obtain solid castings of copper without mixing with it some other material.

And it is well known that even one-half of one per cent. of alloy is enough to reduce the electrical conductivity of the casting to one-quarter that of pure copper. Many processes of mixing or tempering this metal have been invented, but their product has not up to this time been able to show the physical properties of rolled or drop-forged copper.

Some months ago in a new type of rail bond I used strips of rolled copper with cast copper terminals. These castings were made for me by a firm which claimed extraordinary things for their product. I therefore expected very little from the metal, and in making tests was greatly surprised to find that a piece of this metal with but three-eighths of a square inch section could transmit 1,500 amperes for 20 minutes without excessive heating. A calculation based on this performance indicated a conductivity of at least 90 per cent. that of the best rolled copper. As I had never before found cast copper with more than 40 per cent. conductivity, I decided to make a thorough and complete series of tests so as to ascertain the facts concerning this metal, which is called MB copper. A chemical test suggested by Mr. Edison showed that these castings had less impurity than was contained in some sheet or rolled metal sold as pure electric copper. To exactly determine the relative conductivity, I ordered a pattern made from which I obtained castings of the best commercial copper and of the MB metal. These castings were carefully finished so as to present for testing a cylinder 25 inches long and 0.8 inch in diameter; a terminal was left at each end, about 2¼ by 2¼ by 1 inches.

As a basis for comparison I had an exactly similar bar turned up from the best rolled Lake Superior copper. The completed bars were magnificent pieces of metal, without an apparent flaw. The difference in shrinkage of the two castings and a slight variation in the size of the terminals made it impossible to exactly obtain the comparative weight. The terminals of the rolled bar measured 2 by $2\frac{7}{16}$ by 1 inches and its weight was seven pounds six ounces.

The commercial cast bar was a popular process "tempered" copper with terminals $2\frac{1}{16}$ by $2\frac{1}{8}$ by 1 inches; its weight was six pounds nine ounces.

The MB bar's terminals measured 2 by $2\frac{3}{16}$ by 1 inches, and its weight was seven pounds one ounce. Each of the cast bars gave a clear musical tone when suspended and struck; the MB bar, though the heavier, gave the higher tone. Of course the rolled bar was without resonance. The commercial cast bar had accidentally been turned .002 inch too small, but the other two measured exactly 0.8 inch, thus having a section of practically one-half a square inch.

I decided to test the electrical drop in two feet of each bar, and its temperature at from 100 to 1,500 amperes, the latter being three times the proper current for that section of copper. In order to prevent any rise of temperature from the contacts at terminals, each terminal was amalgamated by the Edison process and coated with the Edison flexible solder; there was therefore no appreciable drop at these contacts. In amalgamating the commercial copper bar by the Edison process, fumes were given off with an odor of zinc, and a black precipitate was formed. This was washed off and the process repeated several times until the surfaces remained bright. Both of the other bars yielded instantly to the process without fumes or precipitate.

Mr. Edison states that this is a keen test of the purity of copper, and so it proved, for the analyses subsequently made for me by Ledoux & Co. showed the commercial casting to have 99.15 per cent. of copper; the rolled bar 99.83 per cent. and the MB 99.85 per cent.

In spite of the different characteristics of these bars, the variation in composition is less than seven-tenths of one per cent.

From tests of similar samples, the tensile strength of the commercial cast copper was 19,000 pounds to the square inch, while the MB was 30,000 pounds, which is practically the same as rolled copper.

The cables used for connections were 500,000 circular mils, with triple braided insulation. When heavy currents were used the bare ends of the cables near the bar connections were cooled with wet waste.

The observed temperature of the bars was, therefore, not due to any outside cause. The instruments used were all made by Weston, and comprised a shunt ammeter reading up to 1,500 amperes, a millivoltmeter reading 0.0002 per degree up to 0.01 volt, another reading 0.002 per degree up to 0.1 volt, and a third reading 0.01 per degree up to 1.5 volts. In each case the same voltmeter terminals were used; these were clamped upon amalgamated spots on the bars just 24 inches apart.

A special dynamo driven by Edison motors was used; its field was excited from the Edison mains. By using a rheostat and a bank of lamps the amount of current generated could be accurately adjusted.

The first readings were taken at 100 amperes after about one minute's run; the current was then increased 100 amperes and a second reading taken, and so on until 1,500 amperes was reached. This amount of current was continued for 10 minutes and increase of the temperature and drop noted. The bars were then disconnected and laid upon a wooden floor and their rates of cooling noted. Since the copper resistance tables are either calculated for a constant temperature or were compiled years ago from data based on impure copper, I decided to use as a base of comparison the drop of the rolled copper bar at each 100 amperes. Since the performance of the MB copper came so close to this standard, I repeated the tests on each and found the readings accurately accorded.

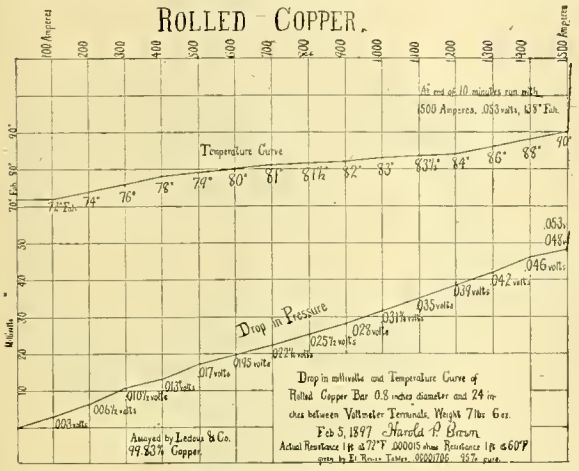
The accompanying curves will show the behavior of the three metals under exactly the same set of conditions. The commercial cast copper averaged less than 28 per cent. conductivity, and before the end of the run scorched the wood on which it rested and the cotton covering the thermometer bulb, as it reached 354 degrees Fah. and 0.22 of a volt drop. Before the test the color of this piece was fine and closely resembled that of the other bars; after the test the bar was a mass of red and silver-colored spots and had lost nearly all its resonance. At the end of the run it had expanded from increase of temperature one-eighth of an inch in 24 inches and 0.002 of an inch in diameter.

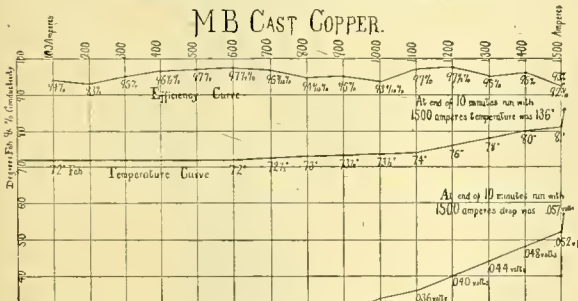
The tabulated results are as follows:

Amperes.	Rolled Copper.		M B Copper.			Commercial "Tempered" Cast Copper.		
	Deg. Fahr.	Mil. V.	Deg. Fahr.	Mil. V.	Per ct.	Deg. Fahr.	Mil. V.	Per ct.
100	72	.003	72	.0032	94	72	.010	30
200	74	.0065	72	.007	93	74	.023	30
300	76	.0105	72	.011	95	78	.037	28
400	78	.0134	72	.014	96	79	.046	27
500	79	.017	72	.017	97	80	.060	26.6
600	80	.0195	72	.020	97.5	82	.071	27.4
700	81	.02225	72½	.023	96.7	86	.086	26.7
800	81½	.025	73	.027	94.4	92	.096	26.5
900	82	.028	73¼	.0295	95	96	.115	24.3
1,000	83	.03175	73½	.034	93.4	104	.130	23
1,100	83½	.035	74	.036	97	110	.145	24
1,200	84	.039	76	.040	97.5	118	.155	25
1,300	86	.042	78	.044	95	126	.165	25.4
1,400	88	.046	80	.048	96	138	.1825	25.2
1,500	90	.048	81	.052	92.3	150	.195	24.6
1,500	138	.053	136	.057	93	354	.220	24

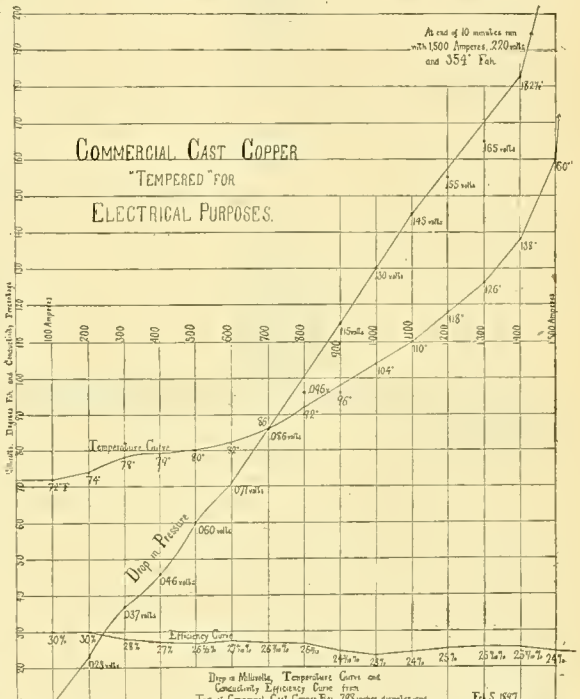
The last set of readings was taken after a 10 minutes' run with 1,500 amperes.

Allowance should be made for its difference in size.





SOME RECENT DEVELOPMENTS IN COPPER MANUFACTURE.



SOME RECENT DEVELOPMENTS IN COPPER MANUFACTURE.

It required two hours and 20 minutes to cool to the temperature of the room. The rolled copper showed a conductivity far greater than called for by the tables ordinarily used. Its actual resistance per foot at 72 degrees Fah. was 0.000015 ohm. In the table published by the London *Electrical Review*, the resistance of a piece of copper 95 per cent. pure, one foot long with a section of one-half a square inch, is said to be 0.00001706 at 60 degrees Fah. Without reducing to the same temperature, the latter resistance is 13.7 per cent. greater than the resistance observed. The tables based on the Matthiessen standard conductivity also show greater resistance; it is therefore wise to use an actual measurement of modern rolled copper as a standard of resistance for cast copper. The rolled copper bar at end of the 10 minutes' run with 1,500 amperes, reached 138 degrees Fah. and 0.053 volt. It had then increased one-eighth of an inch in 24 inches, as did the other, but the diameter increased 0 0005 instead of 0.002 inch. It required one hour and 23 minutes to cool. The performance of the MB copper was a surprise and remains a puzzle. In the test it kept eight to 10 degrees cooler than the rolled bar up to a load of 1,400 amperes. At the end of the 10 minutes' run with 1,500 amperes it reached 136 degrees Fah. and 0.056 volt. Its increase of size was the same as that of therolled bar.

It required one hour and 39 minutes to cool. The varying temperature of the two bars evidently accounts

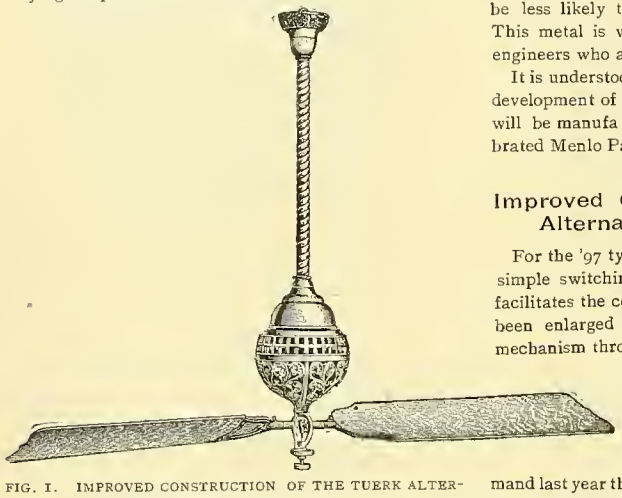


FIG. 1. IMPROVED CONSTRUCTION OF THE TUERK ALTERNATING CURRENT CEILING FAN.

for the up-and-down movement of the efficiency curve between 94 per cent. and 97½ per cent. If in the tests the temperature of the bars should be kept at 72 degrees by allowing time for cooling after each reading, it is my opinion that this curve would be practically a straight line at 95 per cent. or 96 per cent. I need not say that this conductivity is marvelous and opens an entirely new field for dynamo and motor construction and for switchboard work, where a large saving can be effected by using it in place of rolled or drop-forged copper, both of which will warp or twist when heated, while the finished cast metal retains its shape. I know of large multipolar dynamos upon which castings of low conductivity have been used for field coil connectors, etc.; on account of the unsuspectectedly high resistance of these contacts, the calculations concerning compounding have been upset and the dynamos have been failures. Another surprising quality of these MB castings lies in their elasticity. I have fastened in a vise one end of a casting one inch wide and three-eights of an inch thick; the other end, 12 inches distant from the point of support, was bent one inch out of its position, but sprung back when released. I have driven through a seven-eighths inch hole in a hardened steel plate, a plug of MB metal $\frac{57}{64}$ inch in diameter. This required as many hammer blows on the fifth trial as it did the first.

In another experiment I drove into an opening $1\frac{3}{16}$ inches wide between heavy steel rails, a plug of MB copper cut in two pieces lengthwise, the sum of whose widths was $1\frac{9}{32}$ inches, thus compressing the metal $\frac{1}{32}$ of an inch. A current of 1,500 amperes was then passed through the junction, whose section was three-eighths of a square inch, and a drop of 0.018 volt was indicated from rail to rail through the two copper pieces in series. The rails were then separated $\frac{1}{32}$ of an inch more, but the drop remained the same, showing that the copper had resumed its previous width. An analysis of another sample of this MB copper gave the following results:

Copper	99.870 per cent	Bismuth	None
Silver	.034 " "	Lead	None
Iron	.011 " "	Cobalt	Trace
Arsenic	.002 " "	Sulphur	None
Zinc	.013 " "	Oxygen (by difference)	.068 per cent.
Tin	None.		

This analysis is verified by others made by such experts as Ledoux & Co., Booth, Garrett & Blair, Prof. Frank X. Moerk and others, and shows exactly the same results as the best Lake Superior copper. It is evident that no alloy has been used. And yet the process has increased the electrical conductivity and the tensile strength; has given a certain amount of elasticity and decided resonance; has increased the density and changed the structure of the metal.

On presenting this matter to Mr. Edison he accounted for the evident change in the structure of the metal by the theory that the shape of the crystals has been altered so that their lines are parallel, and that the molecules are thus brought closer together and into more intimate contact with each other.

The fact that MB copper can also be rolled or forged adds new interest to its development. As its tensile strength exceeds that of ordinary copper wire, it is certainly worth while to make wire from it in order to determine its strength and conductivity. If it is possible by this process to make as large an increase in the conductivity of wire as it has made in conductivity of cast copper, it will revolutionize dynamo and motor building, and every electric light and railway company will save money by using it to replace its present line wire. And if the tensile strength of the wire is increased by the process, poles can be set further apart and the wire will be less likely to decrease its diameter during winter. This metal is well worth the attention of all electrical engineers who appreciate the value of high conductivity.

It is understood that Mr. Edison is interested in the development of the process, and that the MB copper will be manufactured under his supervision at the celebrated Menlo Park works.

Improved Construction of the Tuerk Alternating Current Ceiling Fan.

For the '97 type of the Tuerk alternating fan (Fig. 1) a simple switching device has been added which greatly facilitates the control of the fan. The oil chambers have been enlarged so that one supply of oil carries the mechanism through the season, or through several seasons, and a number of minor improvements in the detail of construction have been added which will increase the popularity of this apparatus.

This fan sprang into such universal demand last year that before the summer season was over the large factory of the manufacturer, the Hunter Fan & Motor company, Fulton, New York, was taxed to its utmost capacity. The ingenious mechanical arrangement for reducing the speed and transmitting the power of the electric motor is shown in Fig. 2. The switching device which has been added in the type made this year is operated in connection with the blade adjuster. The upper wheel operates the switch and the lower wheel adjusts the blade, which may be done while in motion. In the new type also the upper armature bearing is provided with larger oil chambers so as to eliminate the necessity of oiling for at least a season, and the journals are all made of hardened tool steel. The mechanism includes a motor, a shaft with beveled transmitter wheel, a case inclosing the motor and carrying the fan and beveled intermediate wheels (faced with leather) engaging with the pulley interiorly and exteriorly with the inner face of the case, whereby the case is rotated around the motor, but at a much slower speed. In this construction the transmitting wheels are mounted in swinging frames fastened to the stationary support which carries the motor case, and the weight of the fans and outer case is utilized to produce and maintain the frictional contact of the wheel, because the case and fans are supported by wheels, so that the friction is always the same, and any wear on either pulley wheels or case is automatically taken up and the fan is thus always at a fixed ratio to that of the motor. It will readily be seen that the friction on all the journals is reduced to a minimum, there being no cramping strain, all shafts being perfectly balanced and step with a single steel ball, supported by a hardened steel screw. Means are provided for circulating the oil, and all shafts being set vertically the oil cannot waste. Means are also provided for carrying the motor case in a vertical position in the outer revolving case, by providing the case with a tubular stem in which the armature shaft is journaled, and the outer case is provided with a tubular shank which revolves along the stem, while the armature shaft revolves within it. The letters *B*, *C*, *D*, *D*, in Fig. 2, show the oil reservoir

These fans operate on any of the standard alternating systems and at different voltages ranging from 50 to 120 volts. The actual energy consumed by these motors is from 120 to 140 watts, depending wholly upon the angle of the blades, which are adjustable and can be set at any angle desired. The fans are finished in bronze, ivory and gold, full nickel and polished cast brass.

The Telephone in New England.

[Special correspondence of the WESTERN ELECTRICIAN.]

BOSTON, February 27.—On Thursday last the struggle with the Bell Telephone company for cheaper rates and better service was begun before the legislative committee on mercantile affairs. The fight was led by Representative Kennedy of Holyoke, while Counsel Sam Powers was the leader of the telephone faction.

There were several bills presented. One provides

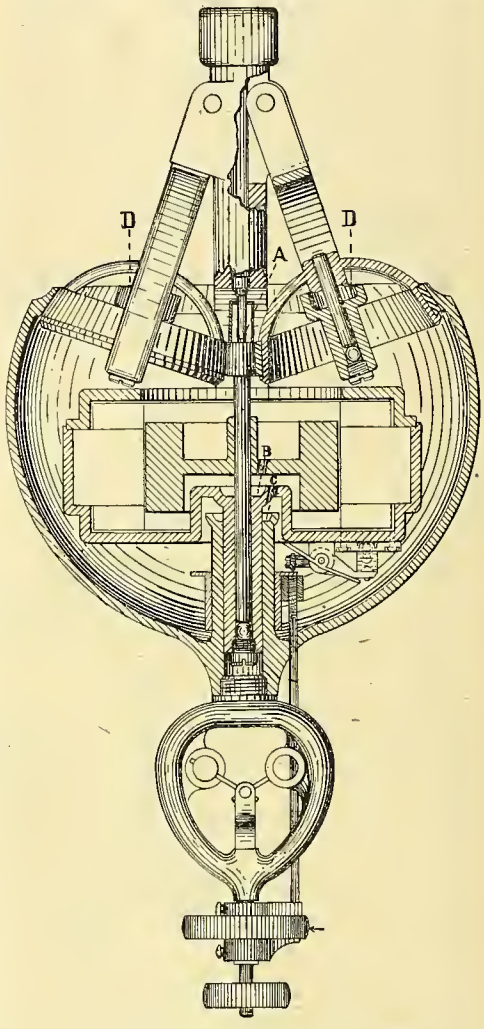


FIG. 2. IMPROVED CONSTRUCTION OF THE TUERK ALTERNATING CURRENT CEILING FAN.

that telephone companies may use the wires of other telephone companies; another that the rates shall be fixed, and the third that the telephone companies shall be under the control of the gas and electric light commissioners.

Following is the text of the bill presented by Representative Douglass of Boston authorizing the appointment of a commission to investigate the rates and charges for telephone service:

Resolved, That the governor, by and with the advice of the council, shall appoint a commission consisting of three persons to investigate the charges made for the use of telephones and rates of telephone service in this commonwealth, with a view to ascertaining whether such charges and rates are reasonable and proper. Said commission shall also inquire into the expediency of regulating telephone rates and charges by state supervision, or the management of the telephone business by municipal ownership.

The several commissioners shall be sworn to the faithful performance of the duties of their respective offices before entering upon the discharge of the same; shall not be in the employ of, or own any stock in, any telephone or telegraph company or be in any way directly or indirectly interested pecuniarily in the manufacture, lease or sale of telephone or telegraph instruments or in any telephone or telegraph company. They may employ a stenographer and shall have power to send for persons and papers, and may receive such compensation as the governor and council shall determine. Provided that the whole expense incurred under this resolve shall not exceed $5,000. Said commission shall

report in print to the General Court on or before the first Wednesday in February in the year 1898, and shall accompany their report with a draft of a bill or bills, if necessary, adapted to carry their recommendations into effect.

Vacuum Tube Lighting.[1]

By M. A. Edson.

Nature controls the human race and holds in check some of the highest ideals of man. We are always restive under the bondage of a master, the secret of which we are ever seeking to make our own to use in the struggle against the physical laws of our earth, against the very sun which makes our existence possible.

The sun not only makes our existence possible at the present time, but has been storing energy in the earth for thousands of years and we are drawing heavily on this store at the present time in the form of coal, oil and gas, not only to manufacture articles for our use and for the transportation of our goods and ourselves, but to supply light for our vocations and recreations at night.

In the past centuries the people were using very little of the total energy of the sun. By night wood and oil from animal life constituted almost the only source and represented energy of only a few years previous, while at the present time we are using the energy of the sun which has been stored in the earth for thousands of years, as well as much of the current power stored in the form of wood year by year; and this means that we are burning the candle, or rather the sun, at both ends at night and in the middle by day. In the past, the light used was due to incandescent carbon, as in the wood torch of the savage, the fish oil lamp of the Romans and the tallow candle of the last century, and even at the present time the incandescent electric lamp is pointed out as a great achievement of science, and yet it is only incandescent carbon in a vacuum, and does not consume the oxygen of the room or give off unconsumed carbon.

With a few exceptions, the electric light of to-day is the result of burning coal under a boiler and producing steam, using the steam expansively in an engine to turn a dynamo to generate electricity which is transmitted by wire to the lamps which produce the light. This train of operations introduces many losses due to the number of times the energy is transformed from one form to another. In the best modern electric light station of large size the net thermal efficiency of the engine plant up to the dynamo is about 13 per cent. The electrical part of the plant shows a better efficiency, especially the dynamos and line, which under favorable conditions will show 90 per cent., but the lamps are where the greatest loss at present comes in. The average incandescent lamp shows under general conditions an efficiency as a source of light four per cent., and an efficiency for the total transformation from the thermal units of the coal to radiant light of about one to 1½ per cent. Very little improvement can be looked for in the steam plant over the present modern construction, and in the electrical part the dynamo has received so much attention in the last few years that the efficiency is raised to 96 per cent. under general conditions and the lines an average of five per cent. The most inefficient part is the lamp, and to the improvement of this we must now direct our attention.

In the first place, how does the incandescent lamp compare in light efficiency with other illuminants?

Oil lamp	3 per cent	Candle	56 watts per candle
Gas—butterfly burner	4 " "	Oil lamp	57 " "
Incandescent	5 " "	Butterfly gas burner	93 " "
Arc lamp	16 " "	Argand gas burner	68 " "
Magnesium lamp	15 " "	Incandescent	3 " "
Geisler tube	32 " "	Arc lamp	0.8 " "

Before discussing the efficiency it would be well to know what is wanted as light and what constitutes good illumination, for after all it is not so much a point of light which is wanted as a general diffused illumination. There is a vast difference between light and illumination. Illumination in a parlor for instance should be so arranged that on entering the room one could distinguish the form and true color of everything in the room, and be able to read in every position one can conveniently hold a book, and while there is plenty of light no single point of light should be visible. The color of the light should conform in a slight degree to the color decoration scheme of the room. In other words, a room with dark red wall paper looks bad in a glaring white light; and again, the best color or wave lengths of the light which is best suited for our eyes should be considered. As is well known, violet light should be avoided. The composition of some of the common lights is given below:

	B. Orange.	D. Yellow.	E. Green.	C. Violet.
Petroleum lamp	16.2	24.6	34.5	24.6
Sunlight, direct	72.0	17.7	7.6	2.7
Sunlight diffused	39.5	31.6	15.9	13.0
Arc lamp	42.3	38.5	15.3	3.9
Incandescent	8.0	26.3	36.8	28.9

The foregoing table by Meyer has a direct bearing on the phenomenon known as the maxima stimulus. This phenomenon itself is well known and has always been an indeterminate quantity in all photometric experiments and is a very serious problem in the solution of illumination problems. As defined by Palez: "The maximum stimulus is the superior limit above which an increase in the intensity of the stimulus produces no increase in the intensity of the sensation." It is not so much in the actual candle power as shown by the photometer as in the composition of the light and the ability to reflect colors in their true color value.

On a bright sunlight day we see more by the red and yellow ray on account of the contraction of the pupil of the eye, as the following table:

	Orange.	Yellow.	Green.	Violet.	Total.
Sunlight direct	2,661	656	231	100	3,701
Sunlight diffused	731	585	294	100	1,710
Incandescent lamp	21	92	137	100	340
Petroleum lamp	35	100	138	100	433

The light of the future will not follow the glowworm so closely as was formerly supposed. The ideal will approach more closely the bright sunshine for an initial light and then diffuse it to some extent.

The reflection and diffusion of light is a problem which does not receive the attention which it should, but this may be due to the wide difference in results obtained with different types of lamps. As an instance of this, the following table shows one reason why a room looks so much different by incandescent lamps than when it is illuminated by diffused sunlight. The light was reflected from four samples of wall-paper. A, C, D were of a yellowish red; B was a blue-green:

Sunlight:	A.	B.	C.	D.
Orange	684.0	259.2	1,512.0	1,540.8
Yellow	189.6	63.7	247.8	481.4
Green	29.6	36.5	91.2	67.6
Violet	7.6	7 6	7.6	7.6
Incandescent lamp:				
Orange	76.0	28.8	168.0	171.2
Yellow	76.2	94.7	362.2	715.3
Green	143.5	176.6	441.6	327.5
Violet	81.0	81.0	81.0	81.0

The foregoing is on a basis of the number of light rays incident reflected. The large amount of green reflected by the rays of the incandescent lamp is not easily accounted for, except that it may be due to a secondary composition of two colors to produce a third, and this may be shown in the following manner:

If the light which is emitting a normal spectrum be directed toward a green surface, the reflected green light may be made to appear brighter by increasing the intensity of the orange rays emitted by the source of light. The spectrum of incandescent carbon varies but little, assuming that the incandescent lamps are maintained at a point where the filament shows white and not red, but a large majority of the lamps at the present day are not run at the proper voltage, and the spectrum of an average lamp is not generally that which the spectro-photometer shows.

The problem now is not so much a great quantity of light, but the quality, and incandescent carbon does not seem to be susceptible of any great improvement, and we must turn to some other phenomenon of nature for a source of light, the quality of which is under better control, and the ability to make a light of any tint directly without resorting to color screens and shades.

The vibration frequency of the visible spectrum is not distributed over a very large range, and it is by blending the various vibration frequencies that we may obtain any quality of light, but we must not destroy the substance which produces the color in doing it, but it must be thrown into vibration without chemical combination. Except in a few cases like a fluorescent screen made of tungstate of calcium or platinum barium cyanide and the phosphorescent substance like calcium sulphide, the light effects in the presence of air are maintained by chemical combination and the generation of considerable waste heat. To attempt to obtain light by vibrating an atom in air without heat is like trying to make a pendulum swing when immersed in a liquid; it either does not swing at all or with the generation of heat. And yet the phenomenon of fluorescence and phosphorescence remains to be accounted for. The physical nature of this offers an interesting field for research, and there is some hope in this direction due to the products of the electric furnace. Many attempts have been made to produce light by the electrical bombardment of a refractory substance in a vacuum.

The work of Nikola Tesla in this direction has been very extensive, and has demonstrated a great many things which are not commercially possible, and a very few which are practical at all. He has directed his efforts more in the direction of producing an intense point of light by the electrical bombardment of various substances in a high vacuum, but in nearly every case the heat was so intense that the lamp could be used only a few minutes. In this connection it may be remarked that the apparatus used did not have the power to raise a very large surface to the point of giving out light. Tesla has worked along another line in connection with high-frequency currents, and that is the luminous effects produced in a tube containing a small amount of gas, the tube having been previously exhausted to a fair vacuum.

"It has occurred, no doubt, to many that as a vacuum tube is made longer, the electromotive force per unit length of the tube necessary to pass a luminous discharge through the latter becomes continually smaller; therefore, if the exhausted tube be made long enough, even with low frequencies, a luminous discharge can be induced in such a tube closed upon itself. Such a tube might be placed around a hall or ceiling and at once a simple appliance capable of giving considerable light would be obtained.

"It would not do to make the tube up of small lengths, because there would be with ordinary frequencies considerable loss in the coatings, and besides, if coatings were used it would be better to supply current directly to the tube by connecting the coatings to a transformer."[1]

Of the several methods considered for producing light by high-frequency impulses the following may be mentioned:

1. The incandescence of a solid.
2. Phosphorescence.
3. Incandescence or phosphorescence of a rarefied gas.
4. Luminosity produced by gas at ordinary pressure.

The first, incandescence of a solid in a vacuum, we may consider out of the argument, as there is not much hope in this direction except in the use of new compounds produced by the electric furnace.

In regard to phosphorescence, a great deal may be said, and it seems to imply greater economy on account of giving out light at a much lower temperature, but most phosphorescent substances lose their luminous power by being subjected to a temperature which is by no means high, and there is also a maximum potential for a given condition of a substance which to exceed will not result in any more light, but often the contrary.

Incandescence or phosphorescence in a rarified gas is supposed to be due to shocks or impacts of the atoms. Just as molecules or atoms beating upon a solid body excite phosphorescence, so when colliding among themselves they produce similar phenomena.

This crude explanation may serve the imagination, but the true nature of the phenomenon is still a little obscure. In a gas discharge each atom vibrates at its own rate, but there is no vibration of the conducting gaseous mass as a whole. It is not probable that the discharge in gas which is well dried produces any electrolytic action, but this is still a question.

Luminosity of gas confined in a tube at ordinary pressure is a subject which has not been extensively investigated in connection with high frequency, and may promise much, but there are many difficulties.

In order to obtain intense luminous effects in any gaseous medium, we must either have high potential or high rate of change per unit time. This is obtained at present in two ways; by the disruptive discharge or spark gap, or the so-called "ether gap" of the Moore system. A simple rise and fall of potential as in a high-frequency alternator cannot give sufficient speed to the atoms. This is one of the objects for which Tesla has been building his oscillators, a species of high-frequency engine-dynamos. But the movement of a wire in a magnetic field cannot produce the desired result, however rapid it may be.

What we require is some means of giving the atoms a quick blow and not a merely increasing push in opposite directions. To do this a species of electrical inertia, similar to the release of a short, thick spring under great tension, is necessary. In the Moore system this is accomplished by enclosing a vibrator in a vacuum and operating it from the outside by a magnet. The self-induction of magnet in turn excites the tube. Now this is a very simple device, but it evidently has a number of faults. It cannot handle a very great amount of energy, so several would be required. It is evidently not a very economical device, as it acts by short-circuiting the dynamos through a resistance and the vacuum must be very high, which is not easy to maintain with much material within the tube, as the occluded gases may be given off for some time. In such a vibrator the contacts evidently disintegrate to some extent, and electrical evaporation must take place to some extent from the material according to the research of Crookes. The best material for the point is not given in the description, but it is probably platinum and aluminum.

The rate of change per unit time may be quite high by this method, but the number of breaks per second is slow and is determined by the time constant of the controlling magnet used, and to decrease the time constant is to decrease the self-induction. The rate of these vibrations is about 6,000 per minute, depending on the tension of the spring and the time constant of the magnet, and the length of time one may be run continuously is not given out.

The tubes used in the Moore system do not appear to be any very great improvement over the ones used by Tesla in some of his experiments, and the statement that they contain a small amount of air must be taken with caution, as it is probable that some small amount of gas is introduced to account for the whiteness of the light, and their great length makes them quite unwieldy.

The whole subject of vacuum tube lighting is in a very crude state, and much quantitive information is wanting, but with time and the work of several different investigators the subject may be brought to something definite, and my own work in this direction may lead to some more quantitive results in the future.

Although much is known of the electrical discharge in gases, the use of internal platinum electrodes makes the result hard to compare with tubes of gas with external electrodes or coatings, and the glass of which the tube is made alters the effect considerably. The several systems of obtaining light by vacuum tubes are subject to the fault of too high potential to satisfy the requirements of the insurance companies, and the use of such potentials is dangerous to the persons using them, and the next step after getting light is to reduce the potential to commercial limits.

It is quite possible that the devices for exciting the tube may be placed in the same relation to the building as the present alternating current transformers, but such delicate parts as vibrators and spark gaps could hardly stand the rough use a transformer is subjected to.

The future work in this direction will require a mastery of three subjects: the theory of light and illumination, chemistry and the design of electrical apparatus, on some difficult problems of distribution, and it would lead to better results if three or four men worked to-

1. Read before the Chicago Electrical association, February 19, 1897.

1 "Inventions of Nikola Tesla," p. 286.

gether, each man being a specialist, as it is unusual to find the three practically combined in a manner which will give good results.

There is another method of illumination which to some may seem visionary, and yet the results if we could obtain them would be the crowning achievement of the century. Briefly it is this: a substance which when subjected to a high-frequency low potential will emit light and is capable of being mechanically or chemically mixed with the pigments used in the manufacture of wall paper, each side and the ceiling of a room to be separately controllable, this substance to be of such a nature that when mixed with a color it will be invisible by sunlight and allow the true color of the pigment to show, but when subjected to a high-frequency low potential will show the color in its true value; the amount of light emitted to be ordinarily at the rate of about one candle power per square foot. The details of such a system are at present obscure, but the new compounds to be obtained by electro-chemical means open up a new field of research, and some of the objections to such a system have been removed and with the improved appliances for obtaining rapid electrical impulses of considerable power, the problem offers an interesting field with some hope of commercial results.

Electricity from Carbon Without Heat.[1]

By Willard E. Case.

Part I.

The subject has such possibilities, all within reasonable bounds, that I hardly know where to commence or finish. At present we have only crossed the boundary line of that field which I am sure will be productive of tremendous results. Thermo-electricity has attracted attention for a great many years, and now and then we have heard of new inventions which led us to think that we were about to solve the problem.

As far back as 1801, Ritter noticed that a current was set up when the junctions of dissimilar metals were heated. And following down to a later date, we find that some thermo-electric batteries were constructed which really produced electrical energy at small cost, and which have been to some extent found practicable. A thermo-cell was described by the speaker before the Royal Society in 1886, which consisted of plates of tin and platinum, forming the electrodes, immersed in a solution of chromic chloride. When the cell is heated the electrolyte becomes active: chlorine, leaving the chromic chloride, temporarily combines with the tin and forms proto-chloride of tin. This chemical action generates electricity, and soon the tin is all converted into chloride and the current ceases. When the cell is cooled this temporary combination of the chlorine and tin is broken up and the chlorine returns to chronium proto-chloride. The tin, being set free, falls as a metallic precipitate to the bottom of the cell in the form of crystals, ready to renew the operation. If this cell works between 80° and 180° Fahrenheit or 538° and 638° absolute, the electromotive force at the higher temperature is about .26 volt, but the possible efficiency is less than 16 per cent., owing to the operation of the second law of thermo-dynamics, which provides that in the conversion of heat into work, the efficiency equals the higher temperature minus the lower temperature divided by the higher temperature reckoned from an absolute zero, the latter being minus 273° Cent. So that this cell is a heat engine, a reversible voltaic cell which passes through a complete cycle. It must be heated to operate, and cooled to regenerate itself. In this connection it may interest you to see in operation a more practical thermo-cell which converts heat into electrical energy. This battery is said to consume 2½ cubic feet of gas per hour, and to generate 12½ watts.

In order to make the subject clear to those who are not familiar with it, let me say that all electricity (except that produced by water power or galvanic batteries) is obtained from carbon. That is to say, our electrical power of to-day is generated by the combustion of coal under the steam boiler or by means of the gas engine, and through the intermediary of engines and dynamo this energy is converted into electricity. Now we all know that this conversion of the potential energy of coal into heat and then into work is a most wasteful process, owing to the intervention of the second law of thermo-dynamics already referred to; and how to overcome this law and to avoid this waste is the subject under discussion to-night. Practically, we only convert a small percentage of the potential energy of the coal into work, a large portion being wasted. It is not so much the inefficiency of the boilers or the steam engine or dynamo which converts this energy into electricity, as it is the method adopted. When we burn coal under the boiler we transform the energy of that coal into heat energy, and the moment we do this we come in conflict with, or rather become governed by, the second law of thermo-dynamics. It is an inexorable law of Nature that under the conditions in which we live a great waste must accompany the transformation of heat into any other form of energy. To illustrate, in hot-air and gas engines, a cold-water jacket is usually employed, and to raising its temperature is diverted the larger share of the heat. In the thermo-pile the junctures must be cooled by a circulation of air or water, and in Edison's pyromagnetic generator the iron tubes must be cooled by application of cold air.

In accordance with the second law of thermo-dynamics, the heat not lost but which we can utilize in a given case equals the difference between the high and low temperatures used, divided by the high temperature. Now, to express this more simply, there is heat of an expansive force in everything down to an absolute zero, but under ordinary conditions we cannot economically use this heat in any machine below the average normal temperature in which we live; so, when once we set up molecular motion called heat, we only use it above the normal temperature—up to that point to which we are limited by the destruction of matter. Or, as we might say, to that point at which we burn out our boilers or melt our containing vessels. And this range is but a small fraction of the total range of the heat we have produced. Lodge has shown us that the energy in a pint of boiling water, if it could be all utilized, amounts to more than half a million foot-pounds, and if the water were quite cold, and on the point of freezing, it would still contain energy of 350,000 foot-pounds of work, or one-sixth of a horse power hour in every pint. Now, coal or zinc could be burned to heat this water to a boiling point, in which case only a part of the energy between that point and freezing could be utilized, which is a small portion of the total range between the boiling point and absolute zero. But either material can be oxidized in a galvanic battery without heat and waste, and electricity produced. If we burn the coal, as Lodge has suggested, the highest temperature commonly available is that of the furnace; hence the heat should be supplied to the working substance in the cylinder at a furnace temperature. This condition is roughly satisfied in internal combustion engines, though they have many defects at present. This furnace temperature is about 2,000° above absolute zero, or 1,500° Fahrenheit, and if in this engine we could cool down to 600° above zero, or 110° Fahrenheit, we could have a possible efficiency of 70 per cent. of the whole—

$$\left\{\frac{2000-600}{2000}=.70\right\}$$

that is, 70 per cent., less the friction of the machine and the loss in the conversion into electrical energy, which would bring it down to something like a possible 50 or 60 per cent. The steam engine does not even approach this. Its theoretical efficiency at 300 pounds is 33 per cent., but in actual operation it is reduced to 25 per cent. Gas engines, internal combustion engines, come near this ideal. In fact, Prof. Thurston[1] states that a cannon when being fired has an efficiency of 50 per cent.

Let it be understood that this is a law of Nature; it is inevitable under the conditions in which we live. No cunningly devised furnace or feed-water heater, or cut-off, or triple expansion apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted, over and above that which we must of necessity lose.

Now, the question which we naturally ask is: How are we to convert this potential energy of the carbon into electricity with the least loss? If the boiler, steam engine and dynamo are not available for our use economically, how shall we do it? We know that the voltaic battery does not act through the transformation of heat into electricity; it produces electrical energy direct. The zinc is oxidized and the potential energy of that zinc is converted directly into electrical energy without the production of heat. The second law of thermo-dynamics is thus avoided, as no heat appears. But, the cost of this zinc and the chemicals employed to oxidize it are so expensive that we cannot afford to use them. The cheapest materials which present themselves at present to our notice are coal or carbon and the oxygen of the air. And if we could convert the energy of the coal into electrical energy direct and cheaply, we could do away with our steam motors, in time, provided the apparatus was simple and practical. Now, there is no known reason why a cheap substance may not yet be found which will act on coal and develop electrical currents in place of heat, but the general tendency of late has been to discard this method and to attempt to find some stable electrolyte or bath which will act as a carrier of the oxygen of the air, conveying it to the carbon and oxidizing it as zinc is oxidized in a battery, producing electricity. This electrical energy would be the equivalent of the heat energy that would be developed by the combustion of the coal in the ordinary way.

Of course in the construction of such a cell we must be governed by the experience we have had with the galvanic battery in which the elements of electromotive force, internal resistance, etc., are involved, and by which, consequently, the output of the cell is governed; such a cell must produce a large amount of energy, be simply and easily cleaned or recharged, in order to be practical. It must be as durable and as simple to use and handle as the steam boiler and dynamo are to-day.

It may be of interest to give you a comparative illustration of what the energy of coal does to-day, through the use of the steam engine, and what it would do provided we could oxidize it in a battery without heat. The average of large electric light plants requires four pounds of coal for every horse power hour of electricity delivered from the dynamos to the line. That is to say, four large stations show a consumption of 4.2 pounds per horse power hour, 49 stations 4.6 per horse power hour, and 32 small stations, 12 pounds per horse power hour. Theoretically, .175 pound of coal will yield one horse power hour, or, allowing for ash, .185 pound; and of zinc, one pound used in a battery produces one horse power hour under a potential of two volts, including the loss in internal resistance. The cubes of these materials represent the weights required by each to produce one electrical horse power hour.

1. Read before the New York Electrical Society, February 24, 1897.

1. *Science*, October 3, 1891.

The Rapid Transit company of Waterloo, Iowa, has let the contract for 800 tons of 60-pound steel rails and a 150 kilowatt generator.

CORRESPONDENCE.

New York Notes.

New York, February 27.—Lexow's committee seems to have no terrors for street railway managers across the bridge. A movement has been started in Brooklyn looking to the ultimate consolidation of all the surface trolley railroads and the two elevated roads in that city. For more than a year the scheme has been in contemplation, and, while no definite conclusion has been reached, a strong sentiment has developed in favor of the proposed union. Such a combination would result in a large saving in the running expenses of the roads, and with the introduction of electricity on the elevated roads the trains could be operated by the surface roads without the expenditure of much more power than is now at hand. One of the officials estimated that the saving would reach nearly $1,000,000 a year. One plan proposed was that a new company should be organized, and that it should lease all the lines, and another that one of the strongest existing companies should be the lessee. The main difficulty to be surmounted will be the division of the earnings. It is said that the proposed plans for rapid transit on the bridge will stimulate the consolidation movement.

Attention is being drawn in Brooklyn to the danger to the water, gas and other underground pipes through electrolysis, produced through the escape of the electric currents in the ground from the trolley railroad wires. Both the Brooklyn Union Gas company and the Edison Electric Light company have recently been making investigations with a view to determine the amount of damage to their plants since the trolley lines went into operation, and actions, it is said, may be instituted against the railroad companies.

Among the new incorporations reported at Albany last week was the Tonawanda Lighting & Power company; capital, $150,000. William B. Rankine of this city, George W. Davenport of Boston and Frank S. Smith of Angelica are named as directors. Another was the Ajax Arc Lamp company of this city, with a capital stock of $100,000. The directors are Bernard H. Pomeroy, Ernest Woltmann, Luther E. Shinn, David H. Gildersleeve, Henry A. Kirkham and Jacobi Loewenthal, all of this city, and Charles S. Van Nuis of New Brunswick, N. J.

Arrangements are being made by the Newark & Passaic Electric Railway company for the celebration of the completion of the link that will connect its road with that of the Consolidated Traction company in Belleville. To celebrate the event Vice-president Hobart will board a trolley car at the city hall in Paterson and will make the trip through Clifton, Passaic, Delawanna, Nutley, Franklin, Essex, Belleville and Woodside to the Pennsylvania Railroad station at Market street, Newark. Mr. Hobart will be accompanied by a large number of friends, and it is said that 10 cars will follow his car. Elaborate arrangements are being made along the line to greet Mr. Hobart as he passes. M. S.

Northwestern Notations.

Minneapolis, February 27.—The Board of Assembly of St. Paul has passed an ordinance making the chief of the fire department an electrical inspector.

Electric lights are being agitated for at Neola, Iowa, and the matter will be voted on at the spring election.

John Balch has resigned as receiver for the Light & Traction company of Dubuque, Iowa., and H. G. Torbert succeeds him.

The North Side Street Railway company, which operates a motor line from the village of Robbinsdale, Minn., to connect with the street railway system of Minneapolis, will substitute electricity as a motive power.

The lowest bids for the electric lighting plant for the water works power house at Madison, Wis., aggregated $1,408. The estimated cost was $800 to $900.

H. N. Bates and Curtis E. Applegard of Boston contemplate purchasing the electric street railway at Eau Claire, Wis., now in the hands of a receiver.

August Jesse of Stillwater made the highest bid for the property of the electric railway company of Stillwater, Minn., of $4,200 and the tax indebtedness of $673 more. This bid is about $1,000 less than the receiver's indebtedness, but it is thought that the court will approve it rather than allow the company to continue to roll up expenses. If the bid is rejected the sheriff will sell the plant March 15th.

John L. Ball has been granted a franchise for an electric light plant at Augusta, Wis.

The electric light plant at Watertown, S. D., is closed

down and the prospects are it will remain so indefinitely. It was established by a stock company, which had never been able to make it a paying investment. The past year it was leased for a nominal sum to an outsider, who was to keep it in repair. As much of the machinery is old and very much in need of repair, it seems impossible to get anyone to take it on those terms.

A survey is being made for an electric railway from Oshkosh to Stevens Point, Wis.

The village council of Perham, Minn., has rejected the petition to call an election to vote on establishing an electric light plant.

E. Briggs contemplates putting in a dynamo in connection with his laundry at Lynnville, Ia. C.

PERSONAL.

W. H. Hochhausen, electrical expert of the Excelsior Electric company of New York, was a Chicago visitor last week.

T. C. Pennington, treasurer of the Chicago City Railway company, has returned from the East, after making arrangements for the meeting of the American Street Railway convention at Niagara Falls next October.

Carl E. Kammeyer has formed a connection with the *Electrical Review* of New York, by which he is the western representative of that journal, with an office in the Monadnock Building, Chicago. Mr. Kammeyer is well known to the electrical fraternity of the West. He is esteemed for his ability and integrity, and his friends' best wishes will follow him in his new departure.

The following-named out-of-town visitors registered at the headquarters of the National Electric Light association, New York, last week: F. R. Donahoe, Chicago, Ill.; G. W. Vallee, Philadelphia, Pa.; James Bradley, Boston, Mass.; E. A. Colby, Newark, N. J.; C. E. Scott, Bristol, Pa.; H. M. Swetland, Fredonia, N. Y.; W. D Sargent, Brooklyn, N. Y.; C. F. Mnoder, Springfield, Mass.; A. H. Pease, Hartford, Conn.; I. R. Prentiss, Cleveland, Ohio.

C. P. MacKie, who for several years was general manager of the Electric Selector & Signal company, is now managing agent of the large cotton estates of Tlahualilo of Mexico. Mr. MacKie has interested a large amount of English capital in this property, which consists of about 150,000 acres of some of the richest land in that country. It is proposed to improve it by irrigation, and purchase the best known apparatus for handling large cotton, wheat and corn crops. A railroad has been built to this estate, and branches will be built covering this teritory. Mr. MacKie announces that electrical apparatus will be installed to make a practical test of the new features in relation to the growth of vegetation under electric light at night. There is at present about one-half of this property under cultivation, requiring the services of 2,000 hands, and this number, it is believed, will be increased to over 5,000 within the coming year.

ELECTRIC RAILWAYS.

Work has been resumed on the Northwestern "L" road, Chicago. There is now about a mile and a quarter of iron on the ground, and this will be put up, together with three-quarters of a mile which will be shipped by the companies at once.

Forty passengers on a trolley car on the North Hudson County railway had a narrow escape from death last week in the Hillside road leading down the bluff from West Hoboken, N. J. The trolley road at that point winds down the hill to the ferry. From the top of the bluff to the level of Hoboken is a sheer fall of more than 300 feet. The car, crowded with guests returning from a reception, had gone down the incline a short distance when the motorman saw something dark on the track. He quickly applied the brakes, but the front axle struck the object with such force as to throw the forward wheels from the tracks. The car then shot toward the edge of the bluff overhanging the abyss. Both the motorman and the conductor applied brakes, and the car was stopped when only a few feet from the edge of the bluff. The motorman fainted when the danger was over, and several passengers were so overcome that they were unable for some time to proceed. The cause of the accident was a large boulder which had fallen on the track from the overhanging cliff. The front of the car was wrecked, and traffic was stopped for several hours.

MISCELLANEOUS.

A corporation to be known as the Southern California Power company has been organized at San Bernardino, Cal., with a capital stock of $1,000,000. The principal stockholders are Henry Fisher of Pittsburg, Pa., and H. H. Sinclair, president and manager of the Redlands Electric Light & Power company. The purpose of the company is to develop power from the Santa Ana River, by taking water at junction of Bear Creek and Santa Ana River and carrying it in a cement ditch and tunnels about four miles, thus securing a fall of 1,000 to 1,100 feet. The power will be transmitted by pole line 75 miles to Los Angeles. It will be the longest line and the highest voltage (30,000 volts) in use in the world. The line will run through San Bernardino, Pomona, Ontario and Pasadena and will supply all power needed in these towns. It is proposed to deliver power into Los Angeles by January 1, 1898.

TRADE NEWS.

The Electrical Supply & Telephone company of Philadelphia has just issued a neat and attractive circular calling attention to its telephone specialties.

H. M. Underwood & Co., Chicago, have been appointed general western agents for the Housatonic company of Wallingford, Conn., manufacturer of adjustable shade holders.

The Chicago office of the Fuel Economizer company closed two important contracts last week, the first being for 1,000 horse power to the Anheuser-Busch Brewing company and the other being a second order from the Armour Packing company of Kansas City, Mo., for 1,600 horse power.

The Standard Telephone & Electric company of Madison, Wis., reports an increased activity in business and growing popularity of its product. The company has recently closed a very fine contract in the East which will cover the installation of about 1,500 telephones when complete.

Thomas Hill, Jr., of 128 Water street, New York, has extended his business to meet the calls upon him for telephone, electric light and power installations, and has also placed machinery for the manufacture of the latest designs in electric sign work and all kinds of electrical advertising novelties, of which he will make a specialty. There will also be a department for electrical repairing in its various branches.

The American Engine company has just secured an order for the entire engine equipment of the new station of the Scranton Illuminating, Heat & Power company, to be built on the site of the old station recently destroyed by fire. The equipment will consist of six American-Ball engines, five of which will be compound and one simple. Direct-connected generators will be used on four of these engines, and the station will be modern in all its appointments.

P. H. Alexander, general manager of the Electric Selector & Signal company, recently returned from London and Paris after an absence of six months. A complete working exhibit of selectors, cut-outs, fire-alarm and telegraph apparatus was shown by Mr. Alexander, in actual operation in London, and was visited by engineers from Belgium, Russia and France. Before leaving London an office was established by Mr. Alexander at 64 Broad Street Avenue, E. C., London.

The Lombard Water Wheel Governor company of Boston has closed a contract with the St. Anthony Falls Water Power company of Minneapolis to furnish seven governors to be used in the new plant now building. These seven governors are to regulate four water wheels each, or 28 water wheels in all, aggregating 10,000 horse power. The style of governor which will be used in this plant is designated by the manufacturers as type C. During the last year the Lombard company has with this type of governor regulated over 40,000 horse power of water wheels in the United States.

The Metropolitan Electric company of Chicago has taken the agency of the Reynolds self-insulating bug cut-out, and has a stock of these on hand from which it can make prompt shipments. This cut-out has some very desirable features. It consists of two pieces of porcelain so recessed and put together as to entirely cover and connect the fuse wire and connections. It is neat and compact in form, and the size is only about three-quarters of an inch in diameter by 1½ inches long. This, with the other desirable features, makes it a cut-out which will fill many requirements of the wiring trade.

The Eclipse sectional rainbow gasket for pipe unions for manholes of all sizes is made from Rainbow packing compound, and all of this product will bear the trademark in order to protect the customers of the Peerless Rubber Manufacturing company of 16 Warren street, New York, from imitations in this line of production. The call for Rainbow packing still continues to be largely in excess of that of any time during the last year, and additional arrangements have been made to meet this large increase of business in this department. It may be interesting to the electrical trade to know that Rainbow packing was first introduced in 1889 by President and General Manager C. H. Dale, the entire process of manufacture being known only to the superintendent, John H. Deming. Its origin is said to have been accidental. A prominent merchant made a suggestion to Mr. Dale, then general sales agent of this company, on constructing certain material. In endeavoring to carry out this suggestion a mistake was made, and from the material on hand it was found that effective flange packing was produced.

BUSINESS.

The Ohio Electric Works, Cleveland, anticipate a congealment of illuminating oils in the spring, when the army of riders appear with Ohio bicycle electric lights. The '97 bicycle electric light is a great improvement over the oil lanterns.

The Chicago Electric Commission company, 169 Adams street, Chicago, dealer in new and second-hand electrical apparatus, is receiving its full share of business. The company carries a large stock constantly on hand and has always many excellent bargains.

Charles H. Besly & Co., 10-12 North Canal street, Chicago, has lately made several large shipments of its specialties to foreign countries. A number four Gardner grinder has just been sent to Berlin, and an order for Helmet lubricating oil and Helmet spring bronze wire from South America has been filled. The company will issue a general catalogue in a few weeks.

The Farr Telephone & Construction Supply company, Chicago, is doing a fine business, and actually has more orders than it can fill. To show the favor in which the Farr company's goods are held it is only necessary to say that shipments are being made to many foreign countries, as well as throughout the United States. A shipment of telephones and supplies is just being made to Italy.

W. C. Ballda, manager of the Utica Electrical Manufacturing & Supply company, has secured a contract from Hugh Glenn & Co. to substitute 40 long-burning Manhattan arc lamps in their stores on Franklin Square in Utica for the incandescent lamps heretofore used. Out of the 640 incandescent lamps formerly used, 100 will be continued in use in the basement. The others will be replaced by arc lamps of 2,000 candle power.

The Electric Appliance company has just prepared a supplement to the Bryant catalogue of electrical specialties, showing a line of the best electric light specialties that have been brought out during the last year. The supplement is also supplied with a special trade discount sheet giving trade prices on the goods listed. The Bryant specialties have a great reputation, and anything new brought out by this company is always received with considerable interest. The Electric Appliance company will send these catalogues with discount sheet to the trade.

The Moon Run Coal company of Moon Run, Pa., is about to install an electric haulage plant in its colliery, and to this end has contracted with the General Electric company for electrical equipment sufficient to operate a mine road with over 3½ miles of track. The generating station will consist of one 165 kilowatt 250 volt generator directly connected to a Harrisburg Ideal engine 18½ inches by 16 inches. These with the switchboard will be set up in the present power house, which now contains an air compressor plant for the operation of pick machines. The inside haulage will be handled by one 10 ton mining locomotive, equipped with 40 horse power motors. This will haul 40 loaded cars per trip, each loaded car weighing about 2½ tons. There will be over 3½ miles of trolley wire in the mines, with the necessary feeders. It is worty of note that electricity was not adopted by the Moon Run Coal company before it had made a more than careful investigation of the merits of all other systems of mechanical haulage, cable, compressed air and steam. The economical showing exemplified by the results obtained in the many other mines now using the General Electric company's system of electric haulage proved conclusively the advantage which would accrue to the Moon Run colliery by the introduction of electricity.

The Chicago Edison company has recently entered the electrical repair field and is already meeting with success. It is claimed that the Chicago Edison repair shops are the largest and best equipped in the West. They occupy the entire top floor of the large station at Market and Washington streets, the entrance being at 76 Market street. The building is 160 feet by 90 feet, which gives a large amount of space. The company has the best of facilities for handling any and all kinds of electrical and mechanical repair work. It has a large oven for baking armatures, with a capacity of seven good sized armatures. The armature winding room is equipped with the latest improved tools for handling all class of armature, field and transformer rewinding, while the lamp repair department is one of the largest in the country, having a capacity to handle the repairs on the 7,000 arc lamps operated by the Chicago Edison company in addition to the great number of repairs made for isolated plants, etc. A well equipped carpenter shop with all the latest improved wood-working tools, where the company manufactures all its own cut-out boxes, etc., is also at the disposal of the repair department. Another important feature is the large machine shop, equipped with the very latest and most improved tools including press, etc., for the erection of commutators of all sizes. At present the Edison company is building a special commutator for a 50 volt dynamo with a capacity of 2,000 amperes. Adjoining the machine shop is the switchboard department in which the company is able to build switchboards from the smallest to the largest size. Passing through this department, a WESTERN ELECTRICIAN representative noticed a very large marble switchboard in course of construction, which is intended to go into the new Public Library. This will be one of the finest switchboards in the city of Chicago. The plant includes also a very large blacksmith shop, where all the forging of every description is done. The instrument testing and repair department is equipped with the most improved instruments for calibrating instruments of every description. Each separate department of the repair shops is under the immediate supervision of an experienced foreman, while the repair shops in general are under the supervision of R. S. Kelsch, superintendent of high-tension system, Chicago Edison company. One of the claims made by the Chicago Edison company for its repair department is that its repair work is handled by men of 15 years' experience. The company not only guarantees first-class work but gives customers the benefit of its experience as operator of hundreds of dynamos and motors.

The special features of the vitrified clay conduit manufactured by the H. B. Camp company of Aultman, O., are so well known to the trade that their enumera-

tion here is unnecessary. Following is a list of users of this conduit: Northwestern Telephone Exchange company, St. Paul and Minneapolis, Minn.; Southwestern Telegraph & Telephone company, San Antonio and Houston, Texas; Public Lighting Commission, Detroit, Mich.; city of Detroit; Telegraph & Telephone Construction company, Detroit, Mich.; city of Minneapolis; Michigan Telephone company, Grand Rapids, Mich.; New England Telephone & Telegraph company, Boston, Mass.; West End Street Railway company, Boston, Mass.; People's Traction company, Philadelphia, Pa.; Union Traction company, Philadelphia, Pa.; city of Baltimore; United States Electric Light company, Washington, D. C.; Fort Wayne Telephone company, Fort Wayne, Ind ; Ohio Valley Telephone company, Louisville, Ky.; Chicago Telephone company, Chicago, Ill ; Central District & Printing Telegraph company, Pittsburg, Pa.; Central District & Printing Telegraph company, Wheeling, W. Va.; Cleveland Telephone company, Cleveland, O.; Charles A. Porter, Philadelphia, Pa.; City & Suburban Telegraph association, Cincinnati, O.; Chicago Edison company, Chicago, Ill.; Central Union Telephone company, Columbus, Toledo and Indianapolis; Cataract Construction company, Niagara Falls, N. Y.; Bell Telephone company of Buffalo; Bell Telephone company of Canada, Limited, Montreal; Bell Telephone company of Missouri, St. Louis; Bell Telephone company of Rochester, N. Y.; Rochester, N. Y., Gas & Electric Light company; Southern Bell Telephone & Telegraph company, Macon, Ga.; Rocky Mountain Bell Telephone company, Salt Lake City; Edison Electric Illuminating company of New York, N. Y.; Edison Electric Illuminating company of Boston, Boston, Mass.; Edison Electric Light & Power company, St. Paul, Minn.; Pabst Heat, Light & Power company, Milwaukee, Wis.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued February 23, 1897.

577,427. Alternating Current Motor. Ludwig Gutmann, Pittsburg, Pa. Application filed February 4, 1891.

Features claimed for this invention are a field magnet core, one or more windings for the same, an armature core, a winding or windings for the armature core, contact terminals connected to the winding or windings, and a block or brush permanently in contact with one armature terminal and temporarily with the others.

577,447. Automatic Circuit Breaker. Granville F. Packard, Fort Wayne, Ind. Application filed September 22, 1896.

Metallic contacts are provided for closing the main circuit between the terminals and high resistance contacts for closing the shunt circuit between the terminals; a pivoted hand-lever carries the bridging contact for the main circuit; an arc-rupturing plate is pivotally mounted on the hand lever, and is adapted to be automatically thrust or interposed across the path of the arc; an armature is provided to which is attached a weight or spring to resist the magnetic pull of the armature, and having a catch or trigger adapted to engage the hand lever when the working circuit is closed, and an electro-magnet is arranged for actuating the armature.

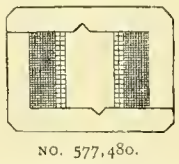
577,450. Electric Railway System. Constant F. De Redon, New York, N. Y. Application filed September 5, 1895.

One feature described is a circuit closer, comprising a permanent magnet, a lever on which the magnet is mounted, a closed casing in which the lever is pivoted, a contact-plate on the lever, contact-blocks for engagement with the plate, and a retarding device for the closer.

577,480. Electric Transformer. Ludwig Gutmann, Peoria, Ill. Application filed April 25, 1896.

The laminated core is built up of laminæ, made each of three sheets or punchings of magnetic material, two of them fitting together from opposite sides of the coils of the transformer, and the third or core-plate proper entering within the coil or coils adapted to interlock with the punchings of unequal length on opposite sides of the axial plane of the coils and with superposed layers reversed.

577,493. Electric Furnace. Francis J. Patten, New York, N. Y. Application filed August 1, 1896.



NO. 577,480.

This is an electric smelting furnace containing a central carbon core constituting one electrode of the furnace, with numerous pencils of carbon radiating from it through the mixture to be fused, the outer extremities being connected to independent leads, whereby they can be given current simultaneously or separately at will.

577,499. Filament for Electric Lamps. John H. Douglas-Willan and Frank E. W. Bowen, London, England. Application filed August 3, 1896.

The process of treating filaments consists in rendering them incandescent in the presence of a compound containing boron, carbon and oxygen

577,501. Electrically Operated Ship's Log. Walter S. Alexander, New York, N. Y. Application filed May 18, 1896.

This is a recording device controlled electrically in combination with a rotator in electrical connection therewith, the rotator having an axial shaft, with a circuit controller mounted thereon controlling the circuit to the recorder, a hollow shell filled with oil or its equivalent suitably mounted to revolve on the axial shaft, and provided with helical blades, and a lug to trip the circuit controller.

377,523. Process of Manufacturing Ozone and By-Products. Gustaf J. Anderssoo and Julius C. Dittrich, Brooklyn, N. Y. Application filed December 12, 1894.

The process is described of manufacturing ozone and nitrous oxides from air, consisting in first freeing the air from carbon dioxide and then drying the same, then ozonizing the oxygen of the air into ozone and oxidizing simultaneously the nitrogen of the same into nitrous oxides by electrical currents of high tension in an ozone generator, and then separating the nitrous oxides from the ozone by absorbing them in suitable liquids.

577,526. Electro-pneumatic Brake. François Chapsal, Paris, France. Application filed September 26, 1896.

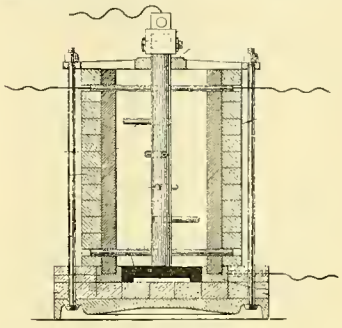
An electrically operated valve for pneumatic brake systems, comprising a magnetic ring rotatively mounted on an axis between pole-pieces, means for sending reverse currents over the ring and thereby oppositely energizing it and causing it to turn in one direction or another, and separate valves operated by the opposite movements of the ring.

577,532. Annunciator. Abraham R. Miranda, Boston, Mass. Application filed November 17, 1896.

A case is suitably provided with a front wall, the hooks extend from the case; checks are suspended on the hooks, the rods extend from the case, and each rod extends above a corresponding check-hook out of contact therewith, but with its forward portion sufficiently near the corresponding portion of the hook to cause the check during the process of removal to come into contact with the rod, and thus electrically connect it with the hook next beneath it; annunciator, hooks and rods being in electrical circuit.

577,533. Combined Check Receptacle and Cash Drawer. Abraham R. Miranda, Boston, Mass. Application filed November 27, 1896.

By means of an electro-magnet checks are deposited in a receptacle for that purpose and the cash drawer thrown open.



NO. 577,493.

577,534. Submarine Telegraphy. Alexander Muirhead, London, England. Application filed November 18, 1895. Patented in England March 16, 1894.

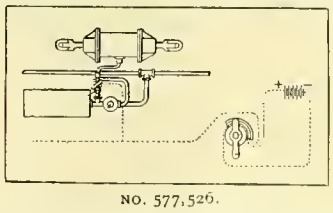
One claim is given: In an automatic telegraph transmitter, the combination with the perforated ribbon-actuating devices, the lever-contact devices adapted to respectively enter perforations in the paper ribbon, whereby battery contacts are established, and a rotating cam serving to restore the contact-lever devices to their normal position, of means for curbing or reversing the current from the battery during the maintenance of the said battery contact.

577,540. Telegraph Transmitter. Herbert A. Taylor, London, England. Application filed November 18, 1895. Patented in England October 30, 1894.

An automatic telegraph transmitter is provided with means for preserving a record of outgoing signals, relays operating through their tongues to close local circuits and bring into action the recording means, a transmitting key with its front bar divided and the coils of a relay in circuit between each of those divisions and the one pole of the line battery, and a switching device serving to put either the automatic transmitter or the transmitting key into circuit.

577,550. Electric and Gravity Pleasure Railway. James A. Griffiths, Philadelphia, Pa. Application filed April 3, 1896.

The claim: In a pleasure railway, an undulating course having upwardly and downwardly extending inclines, a car provided with a downwardly projecting feeder-arm, a trough arranged along the course below the surface thereof, and a feeder-wire arranged in said trough only at the upwardly inclined portions of the course and below the road-bed beneath the trough at other portions of the course.



NO. 577,526.

577,635. Electric Signal for Highway Crossings. William W. Alexander and Manceillia C. Gillham, Kansas City, Mo. Application filed March 23, 1896.

The arrangement includes a railway track, having an electrically continuous rail and a rail comprising sections insulated from each other, an electro-magnet, its armature adapted to vibrate between two contact points, battery connections between the intermediate rail section and the continuous rail, and including the magnet and the contacts, and electrical connections between the armature and the other rail sections.

577,636. Apparatus for Producing Ozone. Emile Andreoli, London, England. Application filed August 12, 1896.

This apparatus consists of a box provided with a false bottom, having a plurality of slits therein, a series of electrodes resting upon the bottom with spaces between them directly over the slits respectively, a sheet of dielectric material between each pair of electrodes and arranged over the middle of each slit, a conical chamber below the false bottom, an inlet passage for air or gas fitted to the apex of the chamber, and an exit for air or gas from the box located at a point above the electrodes.

577,644. Electric Elevator. John P. Casey, Philadelphia, Pa. Application filed June 13, 1893.

A winding drum, a power device to rotate the drum, a lifting cable, a movable part adapted to control the power device, a pawl carried by the movable part, a rotating tooth or ratchet wheel moved by the winding drum or the power device, a movable frame provided with a guide adapted to press upon the lifting cable and furnished with a shoe to forcibly press the pawl into contact with the ratchet wheel, whereby in case the cable becomes slack the shoe and movable frame shall operate the pawl to throw it positively into engagement with the moving toothed or ratchet wheel, and thereby move the movable part to stop the operation of the power device.

577,670. Apparatus for Producing Electric Currents of High Frequency. Nikola Tesla, New York, N. Y. Application filed September 3, 1896.

The combination is claimed with a source of electric energy of a motive device, two condensers, a circuit controller adapted to direct the energy of the source alternately into the condensers, and a discharge circuit through which by the operation of the circuit controller one condenser discharges while the other is being charged.

577,671. Manufacture of Electrical Condensers, Coils, etc. Nikola Tesla, New York, N. Y. Application filed November 5, 1896.

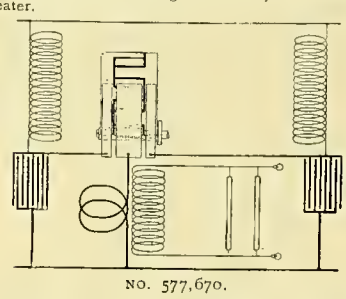
The improvement consists in inclosing the device in an air-tight receptacle, exhausting the air from the receptacle, introducing into a vessel containing the device an insulating material rendered fluid by heat, and then when the material has permeated the interstices of the device, subjecting the whole to pressure, and maintaining such pressure until the material has cooled and solidified.

577,678. Voltmeter. Paul Brandt, Berlin, Germany. Application filed August 6, 1896.

A core or armature for solenoids, comprising a soft-iron sleeve, and a bundle or cluster of wires contained therein.

577,704. Electrical Insulator. Tapley W. Young, Washington, D. C. Application filed September 23, 1895.

A conductor of electricity in combination with an electric heater arranged in proximity to a support of the conductor, and a hood for shedding water away from the electric heater.



NO. 577,670.

577,741. Trolley for Electric Railways. Herbert N. Gale, Bristol, Conn. Application filed October 16, 1896.

Claim one is given: In combination, the trolley pole the forks borne by the trolley pole, having ways for the trolley wheel shaft, the trolley wheel shaft hung in said ways and the trolley wheel rotarily hung on said shaft.

577,742. Electric Transformer. Ludwig Gutmann, Peoria, Ill. Application filed April 25, 1896.

In a magnetic core for electric transformers, the combination is claimed of two U-shaped plates adapted to interlock with one another in such a manner as to be inseparable in any direction other than vertical to the plane of the plates.

577,760. Electric Arc Lamp. George M. Lane, Asbury Park, N. J. Application filed January 4, 1896.

One claim is for the combination with the high and low resistance magnets, the auxiliary magnet, the carbons and feeding mechanism of contacts, the armature carrying the pin, and the armature of the auxiliary magnet connected with the contact-plate.

577,771. Secondary Battery. Henry G. Morris, Philadelphia, Pa. Application filed September 5, 1895.

The cell has supports below the liquor level; there is a battery plate consisting of two or more sections connected together by necks, the upper section being in the form of a beam from which the other section or sections are suspended, the beam-section being part of the active plate within the liquor and resting upon the supports within the cell.

577,816. Device for Controlling Light Effects. Harry V. Arnold, New York, N. Y. Application filed February 24, 1896.

A theatrical display apparatus is described, comprising a projector having a reflector, means for swinging the projector in altitude and azimuth, and a plurality of movable screens for modifying the beam of light carried by and moving with the swinging projector, and electro-magnets moving with the projector and connected to the screens for operating the same independently of each other.

577,822. Electric Cut-out. James F. McElroy, Albany, N. Y. Application filed October 20, 1894.

An electric cut-out consisting of a porcelain block, a curved fuse suitably connected placed in the block, a series of porcelain ribs adjacent to the fuse, with a flexible covering placed over the fuse, so arranged that the gases may escape through the cut-out in a thin sheet in the form of a crescent.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MARCH 13, 1897. No. 11

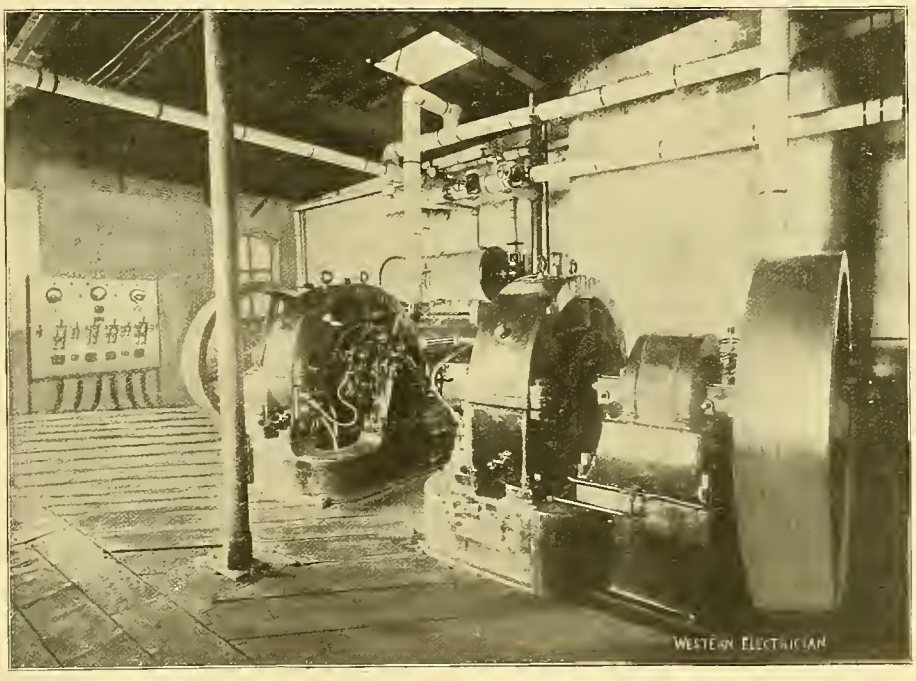
Electrical Plant in the Wisconsin State Prison at Waupun.

Every cell in the state prison at Waupun, Wis.—and there are nearly 600 of them, exclusively for male convicts—is provided with an incandescent lamp, equipped with a key-socket, so that the light is under the control of the inmate. This statement is at first apt to convey the impression that the lawbreakers of Wisconsin are treated to quite a bit of luxury in the way of illumination while undergoing punishment; but of course the improvement was not decided upon without mature deliberation on the part of the officers of the prison, and it was decided that as every consideration of healthfulness, cleanliness and convenience required the use of the electric light, it would be well to go a step farther and place the control of the improved illuminant at the disposal of each cell inmate. In all 2,200 incandescent lamps have been installed in the building, and there are also 18 arc lights on incandescent circuits, which are used for the illumination of the yards and prison wall. Three electric motors of 15 horse power each are included in the plant—one for driving the machinery of the tailor shop and two, placed in the administration building, used for the operation of the ventilating outfit.

The generating plant in the engine room, which has just been completed, is shown by the accompanying illustration. There are two engine-dynamos of 60 kilowatts capacity each, consisting of Ball & Wood engines and Western Electric dynamos. The switchboard is of Tennessee marble and is fitted with round Weston instruments, a voltmeter switch, main-line cut-out and quick-break knife switches. A separate circuit is laid from the switchboard to the warden's residence, several thousand feet distant, which is also electrically lighted. This house, as well as the deputy-warden's quarters, the matron's room and the main offices in the administration building, is fitted with handsome fixtures. In the chapel, library and main halls there are cluster fixtures, but in all other cases plain drop-cord lights are used. The main cable which supplies current from the switchboard to the administration building is lead-encased, with rubber insulation, and has an area of 1,500,000 circular mils. Outside cables are laid underground in iron pipe. The ventilating motors in the administration building were built by the Northern Electrical Manufacturing company of Madison, Wis.

Of especial interest are the wiring features, which exhibit unusual precautions, owing to the character of the institution. Okonite wire is used throughout, and it is encased in interior iron-armored conduit in both of the large cell houses. A cut-out is placed outside of each cell, and from it a twin lead-covered wire runs into the cell to the lamp. Should an unruly convict at any time attempt to damage this lead cable, the only effect would be to short-circuit it and to blow the fuse in the cut-out box at the cell door, thus depriving the inmate of that cell of light but injuring no one else. Not only that, but such an act would deprive the offender of light for a long time, as by the rules it is considered a grave breach of discipline, and the darkness brought on the convict by his own act would not be speedily remedied. All corridor lights are wired in duplicate, and thus in case of an accident to the circuit usually used, or if a convict or convicts should succeed in tampering with the switch controlling the corridor lights, that portion of the building would be plunged in darkness only for a few moments, until word was sent to the engine room, where there is on the switchboard a switch controlling the emergency circuit. In the shoe shop the operations are conducted in a number of departments or sub-shops. Each of these is fitted with its own feeder, cut-out cabinet and main-line switch under the control of the officer in charge of the department. Thus, with these precautions, it would be extremely difficult for the inmates to cut off the whole supply of light in the building in case of an uprising.

The plant was installed under the direction of Chas. G. Armstrong of Chicago, the state electrician of Wisconsin, who prepared the plans and specifications, and the work was executed by the Julius Andrae & Sons company of Milwaukee.



ELECTRICAL PLANT IN THE WISCONSIN STATE PRISON AT WAUPUN.

Opposed to "Slot" Telephones in Chicago.

The sub-committee, consisting of Aldermen Harlan, Walker and Gallager, having in charge the inquiry as to the right of the Chicago Telephone company to use slot-machine telephones, has made its report to the judiciary committee of the Chicago City Council, and its findings have been favorably reported to the council.

After referring to "the manner in which the telephone company attempts to compel its patrons to adopt slot machine telephones in place of the old-fashioned instrument," the report concludes with a resolution that the council instruct the corporation counsel to notify the company that failure to comply with the obligations of the ordinance under which the company is operating will make action by the city necessary.

The object of the resolution, it is said, is to oblige the company to furnish the old-style instrument to subscribers on application at a rental of $150 a year, as provided in its ordinance.

Power House of the Union Traction Company, Philadelphia, Destroyed by Fire.

The big power house of the Union Traction company of Philadelphia, at the junction of Thirteenth and Mount Vernon streets and Ridge avenue, was destroyed by fire on March 3d. Nearly all the equipment was completely destroyed. Two men lost their lives, and several others were slightly injured.

About six o'clock in the evening some of the employes were swinging a big crane around, and the iron chain hanging from the arm struck a generator. The blow smashed the generator, and a violent explosion followed. The accident wrecked all the dynamos which were running. Following the explosion fire started and gutted the building, and destroyed the eight dynamos or rendered them useless.

The building was a three-and-one-half story brick structure. The big steam pipes extending from a dozen boilers in another part of the building, but separated from the dynamo room, broke with a thunderous volley that sounded like an explosion. This frightened the horses attached to the chemical engine and caused them to run away, resulting in the fatalities mentioned.

Steps were immediately taken to repair the damage and orders were placed for machinery and supplies.

The work of clearing away the debris in the interior of the power house was begun almost before the heat of the fire had passed away. It has been ascertained that the standing walls of the building will not have to be pulled down. The board of directors of the company will probably decide whether the building will be reconstructed as a power house or only used as a storage plant. "It is impossible for us to state the exact amount of the loss sustained," said John Lowber Welsh, "until we ascertain whether any of the machinery has been saved from total destruction, but we are confident that the loss is totally covered by the insurance. The amount of insurance on the entire plant was $275,000."

The officials of the company will not admit that it originated from the accidental contact of a chain belt with the brushes of a live dynamo, and the employes who made statements to that effect on Wednesday night have been ordered to leave the matter for official investigation. All the lines affected are running regularly now.

Financial Affairs of Chicago's Storage Battery Road.

The affairs of the Englewood & Chicago Electric Street Railway company came before Judge Showalter again on a petition of G. Herbert Condict, receiver, who desired the privilege of issuing $313,000 of the receiver's certificates to pay off liens and to complete the road. The receiver made a statement of the condition of affairs, showing that the road was indebted to the amount of $253,000 and that it would require $60,000 to complete the power house, equip the road with 20 cars and put it in operation. The necessary authority was granted the receiver by the court, and the work will now proceed to completion

Some Practical Aspects of Electrical Resonance.[1]

By Kempster B. Miller.

It is not the purpose of this paper to treat of the phenomena of resonance in electric circuits from their purely mathematical and theoretical standpoint, that field having been covered in a masterly style by men far more competent to do so than the writer. For very full and interesting discussions of this subject from these points of view I refer you primarily to the articles of Dr. M. I. Pupio, Frederick Bedell, Houston and Kennelly and Francis W. Dunbar.

I trust that I may be pardoned if, in outlining the underlying principles of resonance with as much brevity as is consistent with clearness, I go over a field already covered very thoroughly by others. Analogies and illustrations have been borrowed wherever they seemed to be appropriate, and in the first part of this paper, at least, no attempt has been made at originality.

The phenomena of periodic electric currents in general have almost perfect analogies in the various phenomena of sound, and the further we go into the subject the more beautiful do these analogies appear. Dr.

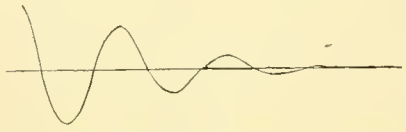


FIG. 1. SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.

Pupin and others have shown excellent judgment in adopting the terms used in acoustics. For instance, they speak of fundamentals of harmonics or overtones, of resonance, of resonators, of consonance and of "tuning" the electric circuit. Nothing can be more apt than the way in which these terms have been applied.

Just as every string or reed in a musical instrument has its natural and fixed rate of vibration, so every electrical circuit containing self-induction and capacity has its natural rate of vibration. By natural rate of vibration of a circuit we do not mean the rate at which the material particles of that circuit would vibrate if suddenly released from mechanical stress, as in the case of the "plunking" of the violin string, but the rate at which an electric current will oscillate in that circuit if the neutral condition of its electrical state be suddenly disturbed.

Self-induction in a circuit causes the phase of a periodic current flowing in it to lag behind the impressed electromotive force. If we have a circuit devoid of self-induction and capacity, the current flowing will be in exact phase with that of the electromotive force producing it; that is, the current value at any instant will be in direct proportion, by Ohm's law, to the electromotive force impressed on the circuit. Insert a self-induction coil and the current lags in phase behind the impressed electromotive force. The maximum and minimum values of the current now occur slightly after the maximum and minimum values of the electromotive force.

Take out the self-induction and substitute a condenser so that the circuit will possess capacity. The phase of the current will now be slightly in advance of that of the impressed electromotive force, and its maximum and minimum values will occur a little before the corresponding values of the electromotive force. It is seen therefore that self-induction and capacity have opposite effects on the phase of the current, the first causing a lag and the second a lead. A little thought will suggest that it is possible to neutralize the lag due to self-induction by the lead due to capacity. In other words, in a circuit with a coefficient of self-induction sufficient to cause a certain alternating current to lag, say 75 degrees behind

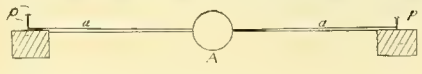


FIG. 2. SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.

its impressed electromotive force, it will be possible to insert enough capacity to cause a lead of 75 degrees in the phase, thus bringing the current again in phase with its electromotive force. When such a condition of affairs exists the current flowing is a maximum, and as it is in phase with the electromotive force, it follows Ohm's law—

$$C = \frac{E}{R}$$

It is found that the amount of capacity which will thus counteract the effects of a certain self-induction, or *vice versa*, the amount of self-induction which will counteract the effects of a certain capacity, will do so for one particular frequency of alternation only. For every circuit, therefore, containing a given coefficient of self-induction and a given capacity there will be one particular frequency, and one only, for which the current will be in phase with the impressed electromotive force, and will strictly follow Ohm's law. The current flowing in such a circuit will be greater for that frequency than for any other with the same impressed electromotive force.

The period of the alternations (that is, the time taken for one complete cycle) at this frequency is found to be the natural period of the circuit. If a part of such a circuit be subjected to a constant electromotive force it will become charged. If now the source of electromotive force is suddenly removed, the circuit will be discharged and the discharge will be of an oscillatory nature. Instead of the potential difference simply decreasing to its normal value, the electro-magnetic inertia, due to self-induction, will cause the current to go beyond the zero point and build up a potential difference of the opposite sign. A discharge will then take place in the other direction, and again pass the neutral point. The cycle will be repeated, each maximum being slightly smaller than the one before. An alternating current of decreasing amplitude thus flows for a very brief space of time until equilibrium is restored. (See Fig 1.) The period of these oscillations is independent of the amplitude of the vibration, and is the natural period of the circuit.

We disturb the mechanical equilibrium of the violin string and it vibrates with a certain fixed rate until it comes to rest; just so we disturb the electrical equilibrium of our circuit and a current is set up that oscillates at a fixed rate until it dies out.

Let us take another mechanical analogy to show even more clearly how this oscillatory discharge takes place. Referring to Fig. 2, we have a ball, *A*, sliding on a horizontal wire. Two rubber bands *a a*, each attached at one end to the ball and at the other end to one of the pins *p p*, located at the ends of the wire, serve to hold the ball normally in the center of the wire. Bearing in mind that capacity in an electric circuit has a direct analogy in elasticity and that self-induction has a direct analogy in inertia, we will consider what happens when the ball is displaced from its normal position and suddenly let go. The potential energy of the ball, due to the tension of one of the rubber bands, is rapidly changed to the energy of motion, kinetic energy, which is greatest when the ball passes through its central position. At this point its potential energy is zero, but its inertia keeps it moving, and as it moves farther it loses kinetic and gains potential energy until the former is zero and the latter is a maximum. The other rubber band then starts the ball back, and so it oscillates with a fixed period until equilibrium is restored. Returning to our circuit, the condenser stores up potential energy when charged. In discharging, the self-induction will not let the current stop when the potential is zero, and, like the ball, the current goes surging back and forth through the circuit with a certain fixed rate of vibration. Just as the rate of vibration of the ball depends solely on its mass and on the elasticity of the rubber bands, so the rate of vibration of the current depends solely on the self-induction and capacity of the circuit.

We may carry this analogy still farther by comparing the friction of the ball on the wire to the ohmic resistance of the circuit.

These points were, so far as I am able to ascertain, first made known by Maxwell. (*Proceedings Royal Society*, 1868.) He simply proved that self-induction could be neutralized by a proper capacity and gave the formulæ.

It is well to state here that the formula for determining the natural period for a circuit containing a given coefficient of self-induction and capacity is

$$T = \frac{2\pi}{10^8}\sqrt{L\,C}$$

T being the leogth of the period in seconds, L the coefficient of self-induction in henrys and C the capacity in microfarads.

Now, what is resonance? Resonance means what its name implies; simply equality of vibration—synchronism. In acoustics a state of resonance exists when one vibrating body is so adjusted or tuned that its natural rate of vibration corresponds to that of some sounding body near it. In alternating current phenomena a state of resonance exists when the natural period of a circuit containing self-induction and capacity is so adjusted or tuned as to be equal to the rate of vibration of the periodic electromotive force impressed on it. By tuning a string we simply adjust its tension or its mass so as to bring its natural rate of vibration into equality with that of, say, a tuning fork. By tuning a circuit we simply mean varying its self-induction or capacity so as to bring its natural rate of vibration into equality with that of its impressed electromotive force.

Pupin has shown that this tuning of the circuit offers a new and simple method of transforming electric energy from a low to a high potential. Referring to Fig. 3, we have an alternator *A*, giving 600 volts, in circuit with the primary coil of a step-down transformer, the ratio of transformation between the primary and secondary of this transformer being as 6 to 1. In the secondary circuit is an impendance coil *D* and a condenser *C*. Under ordinary circumstance the voltage impressed on this circuit is 100 volts. As the speed of the machine is gradually increased, however, the condition of resonance is approached, and the voltage indicated by the voltmeter placed around the condenser begins to rise. The critical point is quite sharply defined and is indi-

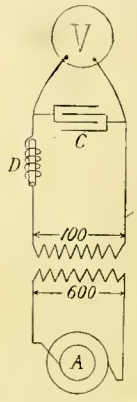


FIG. 3. SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.

cated by a voltage of over 3,000. A further increase of speed causes a very rapid falling off of the voltage. This rise of potential is very easily explained by referring again to our ball and elastic bands. Suppose that at every vibration of the ball a new impulse were given it, and that these impulses occurred in exact synchronism with the vibration of the ball. It is easy to see that the amplitude of these vibrations will become larger and larger, even though the periodic impulse be very small.

Another analogy is in the swinging of one person by another in an ordinary swing. A slight push recurring at the proper interval will finally raise the swing to almost any desired height. Just so in a circuit, when the impressed electromotive force is in resonance with the natural period of that circuit, each impulse given to the circuit serves to push or boost the already existing impulse along until almost any desired voltage is obtained.

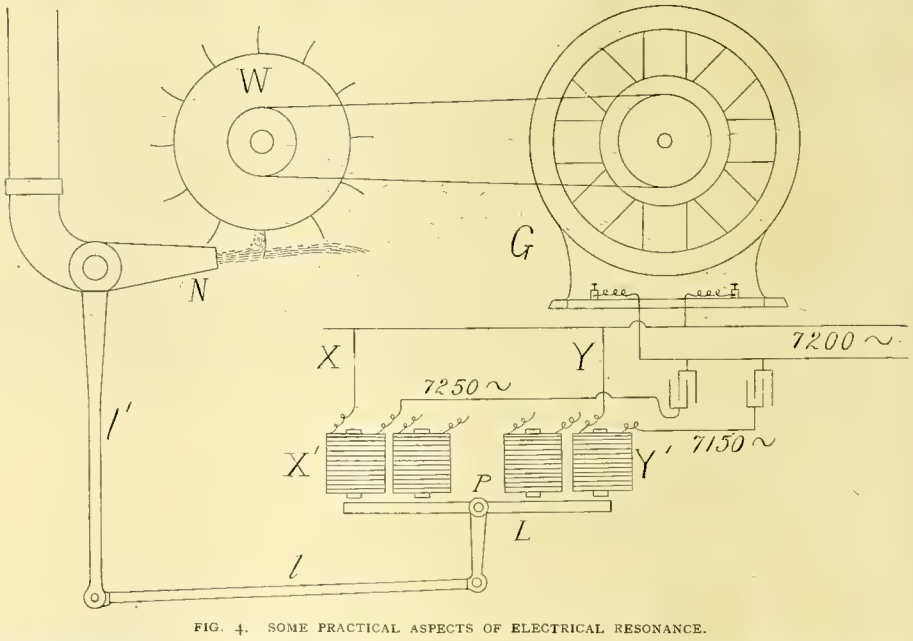


FIG. 4. SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.

This phenomenon is the cause of many serious breakdowns in the insulation of cables. When for any reason an alternating electromotive force is impressed upon the cable the periodicity of which exactly corresponds to the natural periodicity of the cable, the voltage is likely to rise to such an extent as to break through almost any insulation. This is known as the disruptive discharge in cables.

One of the most difficult problems of the day, and one that is declared by many of our leading engineers to be impossible of solution, is that of trans-oceanic telephony. The cables now used for this purpose have an enormous capacity. As a result it is absolutely impossible to transmit through them alternations of great rapidity. High-speed telegraphy is at present impossible and telephony simply out of the question. This, in spite of the assertion of our new Russian friend with the unpronounceable name. Professor Silvanus P. Thompson long ago

1. Read before the Chicago Electrical association, March 5, 1897.

advocated the theory that ocean telephony is possible—that the capacity of the cable can be neutralized by self-induction to such an extent that vibrations of any desired frequency can be transmitted. To be sure, the capacity of the cable is distributed over its entire length, but, as Professor Thompson says, the only way to remedy a distributed evil is to apply a distributive remedy. He proposes to insert in the cable at intervals of sufficient frequency, say five or 10 miles, self-induction coils, so as to neutralize the capacity of the cable. From what has already been said it will be seen that it is possible to so make the cable resonant for one frequency only, and it would thus seem that this method would render possible the transmission of but one particular tone, thus making it available for high-speed telegraphy, but not for telephony, as the vibrations composing articulate speech, with their various harmonics, have a range of several octaves. It may be stated, however, that with a large capacity and a small self-induction the critical period of vibration is not so sharply defined, and that we might make it possible for such a cable to transmit efficiently a comparatively wide range of vibration in the upper register, so to speak.

No one realizes better than myself that certain problems that have more or less engaged the mind of man are impossible of solution. For instance, perpetual motion. But it does seem that in view of the wonders accomplished within the last quarter of a century one is saying too much when he announces that trans-oceanic telephony is an impossibility and will never be accomplished. As Professor Thompson says: "It is contrary to the scientific spirit of progress to admit that any of its developments are final."

Professor Dunbar has shown the advisability of making the electrostatic and electro-magnetic constants of a line neutralize each other for the particular frequency to be transmitted over it.

It has been proposed by several authorities to minimize the current in a line supplying the primary of a transformer by inserting a condenser in parallel with the primary of the transformer and so adjusting its capacity as to neutralize the self-induction. In an investigation of the hedgehog transformer, made several years ago by Dr. Bedell, G. F. Wagner and myself, we succeeded in reducing the current in the line to .18 ampere, although a current of one ampere flowed in the primary coil of the transformer.

The automatic governing of the speed of prime movers and other motors has, heretofore, been effected by one of the following agencies, viz., the centrifugal force or inertia of some moving part of the machine or of some machine driven by it, or by the variation of an electric current or an electromotive force generated directly or indirectly by it. It cannot be denied that these agencies are not absolutely dependent upon the speed of the machine which it is desired to govern. Again, it cannot be denied that the periodicity of an alternating current depends solely and absolutely upon the speed of the alternator producing it. The only thing that would change the frequency of a given alternator would be for one of its poles to drop off, or by some mysterious method to have it pick up another. It occurred to me some years ago that inasmuch as the periodicity of an alternating current seemed to be its only attribute absolutely dependent upon the speed, this would afford a simple and reliable method of governing the speed of almost any prime mover or motor.

Taking a typical case we will refer to Fig. 4, which is merely diagrammatic and intended to illustrate a principle only. *W* is a motor; we will say a Pelton water wheel. *G* is an alternator driven by it. It is desired to run this alternator at a speed that will produce in the line circuit *F F* 7,200 alternations per minute. Across the mains *F F* are bridged two circuits *X* and *Y*, each containing a condenser *C* and a solenoid or magnet *X'* and *Y'* respectively. It will be seen that these two circuits contain both self-induction and capacity. The circuit *X* is tuned to a frequency a little higher than the normal rate of alternation, say 7,250, while the circuit *Y* is tuned a little below the normal frequency, say 7,150. The solenoids or magnets *X'* and *Y'* operate upon opposite ends of the lever *L* pivoted at *P*. An arm of this lever is connected to a connecting rod *l*, the other end of which is connected to a lever *l'* attached to the nozzle *N* which supplies water to the buckets on the wheel. By moving *l'* back and forth the jet is so pointed that more or less of the water impinges against the buckets, and consequently more or less power is imparted to the wheel (this shifting of the nozzle is a very common and successful method of governing water wheels of this class). Now suppose that for any reason the speed of the motor rises and a periodicity of 7,250 alternations per minute is reached. As circuit *X* is resonant for that periodicity, that circuit will at once take current and the left-hand end of the lever will be pulled upward by the magnet *X'*. The rod *l* will be pushed to the left; the nozzle *N* will be pulled down; the jet will partially clear the buckets on the wheel and the motor will slow down. On the other hand, suppose the speed decreases. A periodicity of 7,150 will be reached. The magnet *Y'* will now take current, its circuit being resonant for that frequency. The nozzle *N* will be moved upward, more water will impinge against the buckets, and the speed will increase. In practice it would probably be better to have the resonant circuits operate relays, which will control some mechanical movement so as to move the nozzle in one direction or the other.

It is obvious that this principle may be applied to motors of any type. For instance, the resonant circuits might be made to control a rheostat in the field of an electric motor or the valve gear of a steam engine.

Messrs. Hutin and Le Blanc of Paris, France, have done much work tending toward the utilization of resonance, and one of their inventions, patented in this country, is exceedingly interesting. It is a system of multiplex telephony, and, with one exception, is the only purely multiplex system yet devised. Although it is fraught with innumerable disadvantages, and is, at present, entirely impracticable, it is well worthy of our consideration.

The sounds composing articulate speech are capable of being resolved into a number of components, each a simple musical tone. The lowest of these tones is the fundamental, the others being its harmonics or overtones. The quality or timbre of a composite sound depends on the number of its overtones and on the relation of their respective intensities to each other and to their fundamental. By recombining all the components and giving to each its proper strength the original sound may be reproduced. If, however, instead of recombining all of the components of a sound we select only a part of them, the resultant sound will not be exactly the same as the original, but will differ only slightly from it, and be readily recognizable, provided, of course, too great a number of components be not omitted. To accomplish this analysis and synthesis of sound Messrs. Hutin and Le Blanc make use of the fact that an alternating current of one particular frequency only will be transmitted through a resonant circuit, while currents of all other frequencies will be so greatly reduced as to be relatively insignificant. A combination of a condenser and a self-induction coil is called by them an "electric resonator," it being understood that a circuit containing such a combination will select one particular frequency of current to the exclusion of all others, just as a Helmholtz resonator will select a particular frequency of sound vibration. A combination of several electric resonators arranged in multiple is called by them an "electric current selector."

Fig. 5 shows diagrammatically a telephone system between two cities, *A* and *B*. To each end of the line wire *1*, *2*, connecting these cities, are connected three selectors, *d*, *f*, *g*, and *d'*, *f'*, *g'*, each composed of a number of parallel circuits containing condensers and self-induction coils, or in other words, a number of resonators. To the other side of each selector is connected by the wires *a*, *b*, *c*, and *a'*, *b'*, *c'*, respectively, a telephone set (represented here by the receiver only), the other terminal of which is grounded.

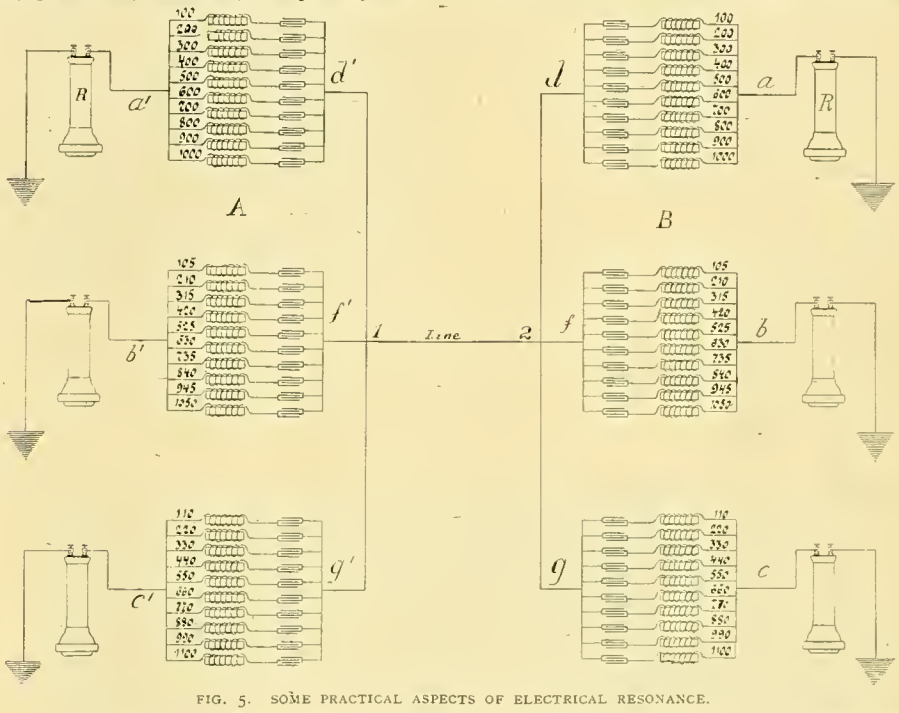


FIG. 5. SOME PRACTICAL ASPECTS OF ELECTRICAL RESONANCE.

As will be noticed from the diagram, the various resonators of the selectors *d* and *d'* are tuned to frequencies of 100, 200, 300 to 1,000 alternations per second respectively; those of selectors *f* and *f'* to frequencies of 105, 210, 315 to 1,050; and those of *g* and *g'* to frequencies of 110, 220, 330 to 1,100. Each selector, therefore, has a range corresponding to a fundamental tone and nine of its harmonics.

Now suppose a sound to be uttered in front of telephone set *R*, connected to the selector *d'* in the city *A*. An alternating current will be generated in the usual manner and will flow from the ground at that instrument to the selector *d'*. Of all the components of this complex wave only 10 will be transmitted through this selector to the line wire *1*, *2*, these 10 having frequencies of 100, 200, 300 to 1,000 alternations per second. At the other end of the line these components will only find passage through the resonators of the selector *d* and will be barred from passage through the selectors *f* and *g*, these latter having no resonators tuned to any of those particular frequencies. After passing through the selector *d* the components are reunited and produce in the corresponding receiver *R* in the city *B* a sound closely approximating that uttered against the transmitter corresponding to the selector *d'*.

The current selector corresponding to any telephone instrument therefore transmits to the line 10 of the components of the complex current generated by the voice; and the corresponding selector at the opposite end of the line picks out this particular 10 from all others that may be coming over the line at the same time, and recombines them into a complex resultant alternating current capable of producing in the receiver at the receiving station a sound almost but not quite a correct reproduction of the original.

To those who have attempted to obtain a delicate adjustment of the capacity and the coefficient of self-induction of a circuit to any desired frequency, the difficulties of this system appear especially great. But whether they are small or great, whether the ideas are practicable or impracticable, no one can deny the beauty of the conception and the nicety with which known physical laws have been utilized in this effort to bring the telephonic art to a higher degree of perfection.

None of the methods herein described has come into general use. The construction of condensers is at present far from perfect. They are expensive, liable to frequent breakdowns, especially when subjected to high electromotive forces, and are very susceptible to moisture and changes in temperature. Moreover, their use is accompanied by a considerable loss due to dialectric hysteresis, although this loss is not as great as that of magnetic hysteresis in iron. It seems, however, that a phenomenon so beautiful must find more general use in engineering works.

It affords another tool to the inventor, the engineer and the scientist with which to better existing methods, or to accomplish some end hitherto unattainable.

Mr. Arnold's Lectures at the University of Nebraska.

B. J. Arnold of Chicago, in response to the invitation of Prof. R. B. Owens, will deliver a course of 10 lectures on "Central Station Design and Construction" before the students of the Department of Electrical and Steam Engineering of the University of Nebraska at Lincoln, Neb. By his own ability Mr. Arnold has won for himself a place in the foremost rank of the representatives of the engineering profession in Chicago, and as he has, moreover, devoted especial attention to power-house construction and operation he is well fitted by knowledge and experience to speak instructively on the subject selected. Prof. Owens is to be congratulated on securing for his students a course of lectures that promises so much of practical value. The first lecture will be given on March 15th, and engineers and others desiring to attend may do so by communicating with Prof. Owens.

Canadian Electrical Association.

At a meeting of the executive committee of the Canadian Electrical association, held on February 25th, it was decided to hold the next convention of the association at Niagara Falls, Ont., on June 2d, 3d and 4th, and committees were appointed to make the necessary arrangements.

The Telephone Exchange company will be organized at Wadena, Minn., to put in a telephone exchange.

The People's Telephone company has been incorporated at Superior, Wis., with $50,000 capital stock. J. H. Culver, C. L. Catlin and H. H. Stewart are the incorporators. A franchise has been applied for.

Claret-Vuilleumier Tramway of Paris.

It has often been remarked that supply will always follow demand, when there is sufficient remuneration in prospect. The inventors of electrical appliances and methods have been peculiarly facile and prolific when such demands have been made upon them. Among the many methods suggested for doing away with the overhead trolley lines there has been an abundance of ingenuity displayed—good, bad and indifferent—in the way of underground connections for this purpose, one of the most peculiar of these being the subject of this article.

The trolley system has been peculiarly objectionable to the Parisians, because of the narrow, crooked streets and the many crossings. It has been characterized as the "chicken coop" and "the spiderweb" system, and to remedy the many objections, a new invention is to be inaugurated with a central station at the outer extremity of the line—at Romainville, just outside Paris proper—its city terminal being in the Place de la Republique, only a step from the Grands Boulevards.

Fig. 1 will give a general idea of the line, which runs from *C* to *U*, through the eastern portion of the metropolis. The dark line represents the double track, while the dotted line shows the single road; *U*, central station; *A*, Avenue de la Republique; *B*, Avenue Gambetta; *C*, Place de la Republique; *D*, Rue de Turbigo; *E*, Grands

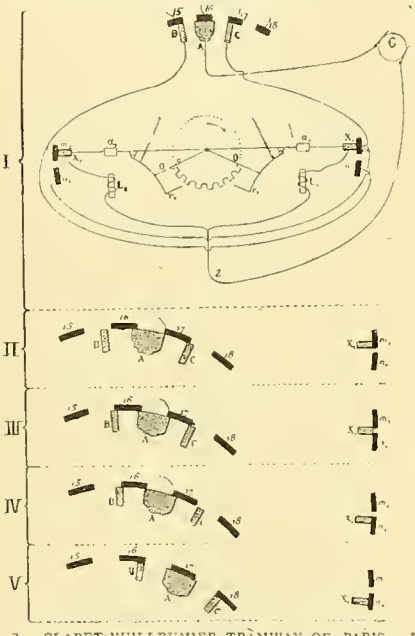


FIG. 3. CLARET-VUILLEUMIER TRAMWAY OF PARIS.—DETAILS OF MOVEMENT OF THE DISTRIBUTOR.

Boulevards; *F*, Boulevard Magenta; *G*, Boulevard Voltaire; *H*, Boulevard Richard--Lenoir; *I*, Avenue Parmentier.

The poles of the dynamo *G* (Fig. 2) communicate with the rail *R*, and with an insulated cable *K*. This cable is connected with distributors placed about 100 meters apart, under manholes in the sidewalk represented by *D*, D^1. The distributor comprises a crown of contact points, marked *a*, *1*, *2*, to *18*, *19*, and three other contacts, *O*, *b*, *20*. Centrally located along the road are placed at about 2.5 meters metallic blocks, level with the surface, connected electrically in pairs by an insulated wire underneath, with the contacts mentioned, as at *15*, *16*, *17*, etc. The contacts *O 1* to *19* and *20* of each distributor are connected electrically to these blocks as shown, but the pairs of blocks *19* and *20* are connected to the next successive distributor D^1 also.

Four rubbing contact arms, *A*, *B*, *C* and *H*, have a rotary motion on the axis of the distributor, contact being made at *E* with the cable *K*, and thence to one pole of the dynamo. In its revolution it may make connection with points *a* to *19*. Its width is such that it will be in contact with any new point before leaving the last.

The rubbers *B* and *C* may also make contact with the same points, but are narrower. A point *Z* of each distributor is in permanent communication with the rail and the dynamo. Through a contact between *C* and *Z* the distributor arm is advanced one notch forward, while a contact between *B* and *Z* reverses the motion similarly.

The dimensions of *H* are such that it may bridge two contacts *O b* or *b 20*, but not all three at any one time.

The car, represented by I^1 I^2, carries a motor connected to the rail through the wheels to one side of the dynamo, and through a moving contact shoe, F^1 F^2, and the metallic blocks, to the other pole of the generator. These contact shoes are of sufficient lengths to insure constant contact with the blocks.

Now suppose the car is advancing in the direction of the numerals and has reached a point where it is in contact with a single pair of blocks *16*, the rubber arm *A* being in contact with that block. The circuit will be complete from the generator *G* through *K*, *E*, *A*, the contact

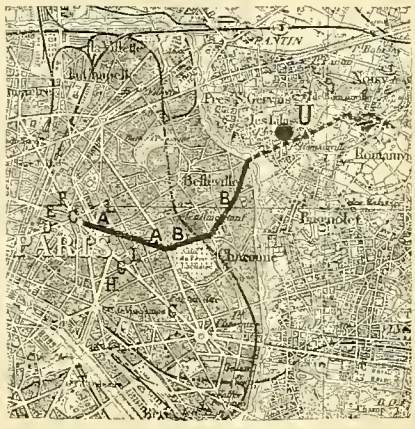


FIG. 1. CLARET-VUILLEUMIER TRAMWAY OF PARIS.—MAP OF EASTERN PARIS, SHOWING THE LINE TO ROMAINVILLE.

of the distributor *16*, the block *16*, F^1, I^1, *R* and *G*. The car advances, the distributor is motionless until contact is made with block *17* by F^2, when a derived circuit is set up through block *16*, F^2, block *17*, contact *17* of the the distributor, *C* and *Z*. This derived current advances the distributor one notch, breaks the contact with block *16*, so that no possible evil result can happen through accidental contact with it. All the blocks save those in actual use are constantly isolated from the circuit. If the car is moved in the reverse direction, a similar action in reverse order is set up by *B*. When the car leaves the field of usefulness of one distributor and enters that of another, the double contacts, as at blocks *19 O* and *20 1*, in the manner just described, move the distributor arm A^1, as before, for when one distributor has finished its work the sweep is in position to act for the next car, one entire revolution being made for the passage of each car.

Fig. 3 shows the movement of the distributor in detail. The same letters indicate the same parts as in Fig. 2, but in different positions. The numerals *15*, *16*, *17*, *18* indicate four of the 20 contacts on the circumference of the distributor.

The rubber *A* is in constant contact with one of the dynamo poles. The rubbers *B* and *C* are in contact with four connecting points m^1, n^1, m^2, n^2, as shown.

Upon the shaft of the distributor, and turning with it are: First a wheel of 20 teeth solidly fixed to the rubbers *A*, *B*, *C*; second, a bar carrying two metallic insulated rubbers N^1, N^2, two armatures of soft iron a^1, a^2, belonging to the electro-magnets L^1, L^2; third, two rachets, independent of each other, which are normally separated from the wheel. The point *Z*, which communicates with the rails and one pole of the generator, contacts with the two electro-magnets L^1, L^2, and hence with the rubbers N^1, N^2.

In a state of repose there is a contact between N^1 and m^1, and between N^2 and m^2. According as the arm is drawn by one or the other of the magnets, N can be made to contact with m^1 and n^1, at the same time, or either singly or neither at will; the same is true of the opposite combination.

Assume that the rubbing contacts *A*, *B*, *C* are in the position indicated by Fig. 4, *I*, and the car shoe is in contact only with the blocks *16*, and hence with the contact *16* of the distributor. The contacts *15* and *17* are isolated and no current can energize the magnets. The car advances to the blocks *17*, and an electrical connection is established between contacts *16* and *17*, through the corresponding blocks and the shoe of the car. This circuit is shown in the dotted line between *16* and *17*. Current is thus set through L^1: a^1 is attracted, carrying with it N^1, a^1, a^2, N^2, in the direction of the arrow. The arm strikes the pawl r^1, which moves the toothed wheel, and with it all attached parts, including *A*, *B*, *C*. These last and the sliding contact N^1 occupy successively the positions (*I*, *II*, *III*, *IV*, *V*) indicated in Fig. 4. These changes occupy less than a second of time each, and the arm completes one entire revolution as the car passes over the section.

Reversing the motion of the car throws L^2 into service, and the arm acts by a reversed motion.

The crossing of tracks is simple and is easily understood by a glance at Fig. 4. A cross connection at the intersection accomplishes the desired result readily and effectively. Switching is also as readily accomplished. Fig. 5 shows the road in course of construction, and Fig. 6 the completed road, along the Avenue de la Republique. Details are given in the *Revue Générale des Sciences*, from which the illustrations are reproduced.

That it is open to criticism goes without saying, but it

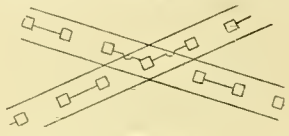


FIG 4. CLARET-VUILLEUMIER TRAMWAY OF PARIS.—PLAN OF CROSSINGS.

it is claimed that there are decided advantages attained, if experience proves that such a system is practicable. Of course the great and lasting objection is the tearing up of the thoroughfares of a busy city,

Explosion in Boston Subway.

An accident, by far the worst of its kind ever known in Boston, occurred at a few minutes before noon on March 4th, when an explosion of illuminating gas in the subway at the intersection of Tremont and Boylston streets caused the death of six persons and the injury to a score or more of others, although not more than 10 were severely hurt. Buildings for hundreds of feet in all directions were damaged by the concussion, and several electric cars which were passing at the time were wrecked. One of these caught fire and was burned to the trucks. The force of the explosion carried away a bridge which spans the subway, and a trolley car, which was completely overturned and broken in two. The property loss includes not only that sustained by real estate owners, but also that resulting from a general

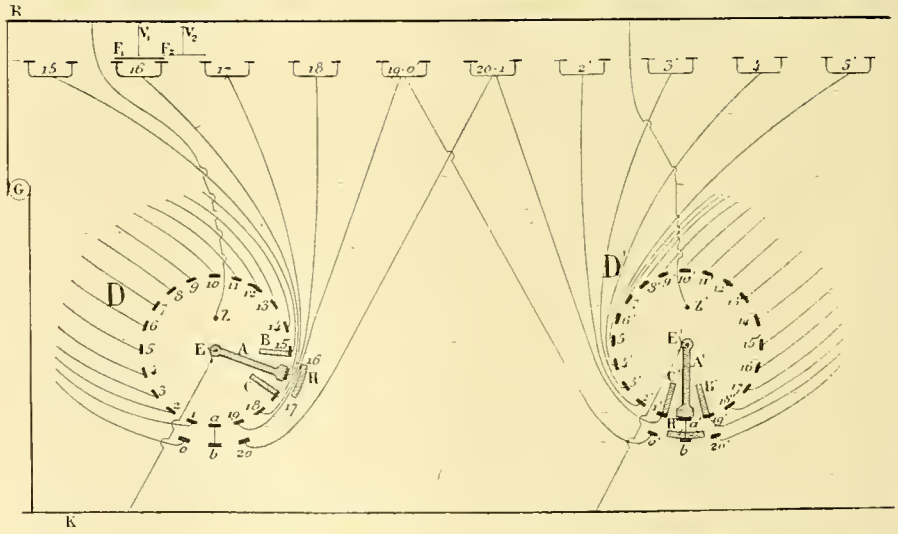


FIG. 2. CLARET-VUILLEUMIER TRAMWAY OF PARIS.—PLAN OF DISTRIBUTION.

demolition of goods in several of the stores in the vicinity. The buildings damaged included the old Masonic Temple, the Heed building and Hotel Pelham.

The explosion is thought to have resulted from the ignition of gas from a leaky main, either by a spark from a passing electric car or from an improperly insulated wire in the subway. An investigation to determine the cause will be held. The property loss will, it is thought, reach $35,000.

Wave Motor Tested in California.

A public test of a new wave motor was made near Los Angeles, Cal., March 6th on the beach three miles from Redondo, from the end of a 100-foot wharf. Parvin Wright, the inventor, conducted the experiments. By means of the float, a hydraulic compressor was actuated, forcing the water into a pressure tank under a working pressure of 400 pounds to the square inch. The water pressure tank operates a Pelton wheel, which drives any kind of machinery. In the test an electric generator was used. Where the machinery was located 500 feet from the beach with a four-foot tide and 6-10 float, five horse power was easily generated.

The machine is automatically regulated and is so arranged that during storm periods no more than a given amount of power or pressure can be accumulated. Wright says the failure to provide such a device has heretofore rendered all wave motors useless. Further experiments will be made at a greater distance from the beach. In the press dispatches from which these details are gleaned, it is stated that Wright figures that during the minimum wave movement he will develop one horse power on every foot of ocean frontage used. The cost of steady power at the coast will not exceed $10 per horse power per annum. Power can be delivered in Los Angeles for $25, about one-third the present cost.

The Electric Light for Coast Defense.

Considerable attention has been devoted by the War Department to the practicability of employing the searchlight as a part of our coast defenses, particularly on the Atlantic seaboard; and the great German projector exhibited at the World's Fair was purchased by the government and mounted on the fortifications at Sandy Hook. It is interesting, therefore, to note the views held abroad on this subject after practical tests. A lecture on "The Application of the Electric Light to Coast Defense" was delivered not long since by Capt. M. A. Boyd of the British Army, who is connected with the Submarine Mining Establishment at Plymouth, England. A synopsis of the lecturer's remarks is given in an English journal:

Capt. Boyd said that it was not to be supposed that with the aid of electricity they could turn night into day over any large area of water, but if they could materially reduce the liability to attack at important points during the periods of time when attack would be most effective, they would have succeeded in materially strengthening the defenses at one of their weakest points.

Small vessels could be distinguished in a concentrated beam at distances from the projector of from 3,000 to 4,000 yards, and in a 16-degree dispersed beam at from 1,500 to 2,000 yards. The great power of a concentrated beam and the intense brilliancy with which it lighted objects at a long distance were of great value; but its area of illumination being small it required to be kept very carefully on the target. This was difficult unless it was controlled by an observer in a good position. By multiplying the searchlights the result would be confusion, and it was therefore generally considered desirable to restrict the employment of searchlights, and use dispersed beams, although their range was short. The typical defense of a large military port would be a scheme of concentrated searchlights, in an advanced position, 16-degree dispersed beams behind, in connection with the mine fields, with possibly 30-degree beams commanding any narrow passages or boom obstructions.

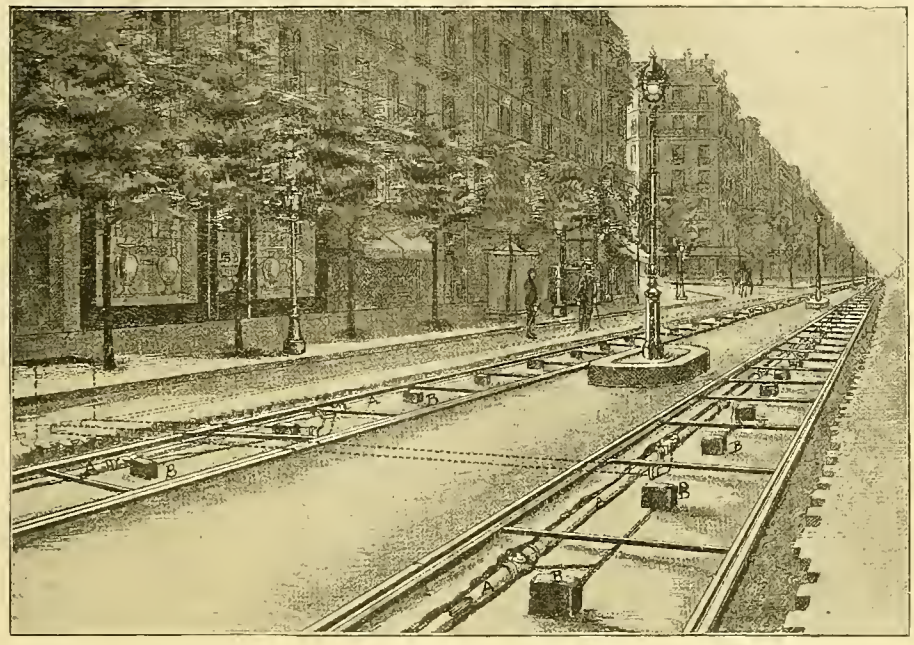


FIG. 5. CLARET-VUILLEUMIER TRAMWAY OF PARIS.—BUILDING THE ROAD; FEEDERS SHOWN IN DOTTED LINES; A, CONDUIT CONTAINING THE CABLE IN THE TRACK; B, METALLIC BLOCKS.

The principal ports had been provided with apparatus for the last 16 years, and periodical practice was carried out. In 1889 some important trials were carried out at the Isle of Wight, Malta, Bermuda and Jamacia, and searchlights were freely employed. In those operation concentrated beams only were used. The attacking vessels represented battleships, and heavy guns were fired by the defense. The deductions drawn in the reports laid stress on the serious effect of smoke, the importance of placing the projectors on low sites, and of providing effective control of the searchlights. In 1890 experiments were again carried out at the Isle of Wight at Sheerness, and in the Thames. At the Isle of Wight operations eight lights were in use, all but one being concentrated beams. One dispersed beam was used, but it was not entirely successful.

The results obtained seemed to show that a satisfactory state of efficiency had been achieved as regarded the apparatus for the production of the light, but a general feeling prevailed that some guiding principles should be laid down as regarded the organization of coast defense generally, in order to meet the recognized changes in the probable form of attack.

In 1892 some instructive trials took place at the Needles, six lights being used—three fixed and three search. Included in the six were four 30-degree dispersed beams. The navy took part, and all attacking vessels steamed at high speed. The trials exploded some too sanguine estimates which had been formed of the power of the light, but it was made clear that the Needles passage could be so illuminated as to make it practically impossible for vessels to pass without being seen when everything was in readiness.

Trials were carried out in Plymouth Sound in August, 1895, and December, 1896, with a view to providing the best dispositions of the lights to meet local conditions. In the 1895 experiments two lights were placed in Cawsand Bay, two at Picklecombe, and one on a lighter near the Breakwater Fort. The Cawsand Bay outer light was used as a searchlight. It was found that 30-degree beams were very inadequate to illuminate vessels on the most probable line of attack. The lights were at first placed on the top of Picklecombe, but subsequently were moved to a much lower position. The trials carried out in December last were much more complete. Nine beams were employed, and lenses of 16 degrees dispersion were substituted for those of 30 degrees in all the wider channels, and in addition the lights were more powerful. The usefulness of the trials was greatly enhanced by the fact that attacking vessels were represented by six torpedo-boat destroyers, which entered the harbor at 18 or 20 knots. Observers were posted at all the important points around the sound, and time records were taken both of the moments the destroyers passed fixed points, and also of the periods the vessels could be seen by the observers on shore. The results showed clearly that under the conditions of the trials, the weather being rough and sometimes misty, the vessels could not enter without being seen. On the other hand, it appeared that the average time a vessel remained under fire from one point was only from a minute to a minute and a half, and that the average time between the first alarm and the arrival of the vessel at the inner defenses might be from 12 to 15 minutes.

Chicago's Proposed Underground Trolley System.

The General Electric Railway company of Chicago is preparing to renew its canvass for an underground trolley line in Lake avenue, from Forty-ninth street to Stony Island avenue. This route was mapped out in the second ordinance introduced by the company, but before its passage Lake avenue and some other residence streets were withdrawn, owing to the strenuous objections of property owners. The company's agents now say that the project was only temporarily withdrawn, and that they intend to build a line in Lake avenue to meet the expressed wishes of residents of the vicinity of Jackson Park. The only down-town routes from this district are the Illinois Central or the Chicago City Railway company's line in Fifty-fifth street and Cottage Grove avenue. It is claimed that there is a genuine demand for additional transportation facilities, and that an underground trolley line will not mar the beauty of residence streets. The General Electric company, in its two ordinances, has obtained over 30 miles of streets in the South Division. The company is now preparing a canvass for about 20 miles more, including a straight line in Calumet avenue to Pullman and adjacent suburbs.

FIG. 6. CLARET-VUILLEUMIER TRAMWAY IN PARIS.—THE ROAD COMPLETED.

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WE take pleasure in noting the arrival of the "Advance Agent of Prosperity." According to the best informed authorities on financial and commercial conditions, he is not as far ahead of the show as has been generally believed.

SEVERAL months ago there was considerable discussion of the question of liability of a corporation for damages caused by lightning coming into a building over a telephone wire. Action for $20,000 had been instituted in New York by the father of a young man who was killed in September under these conditions, but the telephone company has settled for $3,500 and the case has been withdrawn from the calender. This would seem to indicate that the corporation did not relish the idea of letting the case go to trial.

EVERY thoughtful student of history must be impressed at this time with a realization of the progress that has been made through the instrumentality of private enterprises in the matter of collecting and transmitting news. During the last few years, comparatively, there has been more advancement than marked preceding centuries. And the credit for this can justly be claimed by the telegraph, which, conducted as a private enterprise in this country, has ever faithfully served the public, though sometimes at great pecuniary loss and without so much compensation as a word of gratitude.

IT is not at all probable that American inventors of electrical devices will go to the trouble of taking out patents in Ceylon, but if there should be any adventuresome spirit bent upon exploiting his ideas among the Singhalese, he will find the provisions of the patent law of Ceylon in the current number of the *Official Gazette* issued by the United States Patent Office.

AMONG the many freak bills that have been introduced in numerous legislatures throughout the West and South where Populistic ideas prevail, one now before the House of Representatives of Missouri merits special attention. Representative Crisp, who is greatly interested in the improvement of the condition of wage-earners, has introduced a bill providing that telegraph companies in Missouri shall charge 15 cents for the first 10 words in a message and one cent for each additional word. This measure should be hailed with delight by the telegraph operators of Missouri who believe in Populistic ideas. It is an excellent opportunity to determine whether the wages of employes will be increased by having the receipts of their employer cut down 40 to 50 per cent.

WITH the retirement of Martin J. Maloney from the office of attorney-general of the state of Illinois there is removed from public service a very interesting character. The big corporations of the state experience a feeling of relief after the contentions of the last few years. It is true that Mr. Maloney was a picturesque figure at Springfield; he afforded much amusement to the general public and gave the newspapers plenty of sensational articles; but he was at the same time a source of serious annoyance to the big corporations, including the street railway and lighting companies, and he put them to considerable expense as well. Now that he is out of the way they hope they will be able to devote a larger percentage of their earnings to dividends than during his term of office.

CAN a street railway company tie up the bank account of a dismissed employe whom it accuses of dishonesty on the ground that the money deposited in bank is a part of the plunder? This interesting point has been raised by the Consolidated Traction company of Newark and Jersey City, which has brought action in the Court of Chancery at Newark to restrain the Howard Savings Institution from paying $1,400 to a former conductor. The company alleges that the money is part of the plunder obtained in an organized scheme of robbery by means of fraudulent transfer tickets. The defendant asserted that all but $100 of the money belonged to his wife, and that $500 was deposited in the bank before he was employed by the company. This statement was corroborated by the ex-conductor's wife. The court reserved decision.

THERE seems to be no limit to the ambition of engineers, inventors and promoters. Having "harnessed" Niagara, it is now proposed to perform a similar office for the Pacific ocean. A California inventor has devised a wave motor by which, it is claimed, power can be developed and transmitted electrically at slight cost. The details of the scheme are not given in the press dispatches which announce the successful public test of the contrivance near Los Angeles last week, but it is claimed that it is provided with an automatic regulator that removes the chief objection that has been raised to machines of this class that have heretofore been introduced. The inventor, Parvin Wright, claims that "during the minimum wave movement he will be able to develop one horse power on every foot of ocean frontage used," and that the "cost of steady power at the coast will be $10 per annum." A practical and economical arrangement of this kind would be welcomed by power consumers, and it remains to be seen whether the present scheme will meet the requirements or prove unequal to the exacting demands of commercial use.

POWER transmission by means of electricity is occupying considerable attention in Canada at the present time, and the experience of the American companies at Niagara, it is anticipated, will determine whether similar work will be attempted in the Dominion. The Canadian Niagara Power company, which has had exclusive rights to employ the power of Niagara within the limits of Victoria park since 1892, has not availed itself of its privileges, although it has paid the yearly rental of $25,000 required for the first 10 years out of the 20 covered by the law and the contract. The leading newspapers of the Dominion find fault with the company because it has failed to develop the power which it controls and has kept others from doing so, but the management says there is really no cause for complaint, as the park has certainly received great benefit from the annual payment of $25,000. Besides the members of the company have not taken any dangerous risk, and they do not propose to do so, as they can afford to wait and see what comes of power development on the American side. There are no manufacturing industries of any account on the Canadian side at Niagara Falls, and it is admitted that there is no prospect of any. Therefore, if the power of Niagara is to be used at all it must be transmitted, and the conservative Canadians do not propose to take any such risk until they have determined whether the experience on the American side will justify further investment.

FOLLOWING the example of many similar organizations, the National Electric Light association has decided to hold its twentieth meeting at Niagara Falls in June. There is much to be said in favor of the selection of the executive committee; the time of the year is most pleasant for a trip to Niagara, and central station men cannot fail to be attracted by the great work that has been accomplished there, but other considerations raise doubts as to the wisdom of the decision. There was a general desire to have the next meeting held in Chicago because of the advantages afforded, the encouragement that would be given to trade in the West, and the commanding importance of this town in the electrical business. It was believed, too, as a matter of policy, that a meeting in the West would prove advantageous, as it would serve to counteract the growing impression that the association is purely an eastern organization, that it is engaged solely in protecting and encouraging eastern enterprises, and that its interest in the West is gradually diminishing. It is to be regretted that there has existed just cause for such complaint, and that this last act of the association will not have a tendency to increase the interest of western central station men in the National association. We presume that the executive committee gave these matters consideration before announcing its conclusion, and that it had good reasons for making its selection in the face of these facts, but these reasons have not been made public, and there are many people, in this part of the country at least, who have the interest of the organization at heart, and would like to know what determined the action of the committee in making the selection of Niagara Falls.

WE are at a loss to account for the appearance on March 3d of an item in the news columns of the *Sun*, and among the telegraphic dispatches sent out by the press association from New York, calling special attention to the "announcement in the current issue of the *Electrical Review* of the new discovery in the art of casting copper." Of course reference is here made to the contribution of Harold P. Brown, which appeared simultaneously in the other electrical papers, although the impression sought to be conveyed seems to be that the *Review* had exclusive publication. We cannot understand why the *Sun* should discriminate against the other New York electrical papers. Many explanations have been offered, but they are all unsatisfactory.

It has been suggested that our contemporary employs an enterprising and industrious press agent in its effort to create a favorable impression upon the general public as to its standing, but we place little reliance in this. The hard times, we imagine, would restrain the *Review* from indulging in such a luxury as a "standing" which it could only acquire now at considerable expense.

Can it be possible that our eminently respectable contemporary is drifting into "new journalism," and that, as has been pointed out, this is but one instance of many where the dear public has been gulled? Perish the thought.

Surely it cannot be that the publication of an interesting article by our contemporary is such an unusual event as to warrant special mention in the daily press. Such a suggestion must be classed as a base insinuation worthy only of those who would detract from the merit of that publication and begrudge it that consideration for which its claim to dotage entitles it.

But, after all, what is the true explanation of this singular announcement?

Barrett's Revenge.

[Editorial from the *Chicago Record*, March 9th.]

A technical journal of this city, which draws its inspiration from City Electrician John P. Barrett, is now engaged in blackguarding Professor Stine of Armour Institute and W. H. Merrill, both experts in electrical science, because of the report made by them recently regarding certain fire-alarm boxes. In this report serious defects were pointed out in Professor Barrett's favorite box, which he causes the city to purchase exclusively, at a price which should be the subject of quite as close investigation as the quality of the box itself. It is clear that Professor Barrett's mouthpiece finds scurrilous epithets more convenient weapons than facts when engaged in an effort to break the force of the telling stroke which those two gentlemen gave to the peculiar business methods of John P. Barrett.

The *Record's* investigation of Barrett's dealings with electrical concerns indicates that no small part of his protection from proper criticism lies in the system of abuse hurled at any man who dares to call into question the doings of the great Barrett. It is strange that this man should have been permitted to work his will with city contracts in the face of all the facts regarding his methods. The *Record* ventures the opinion that Chicago is getting very weary of this man Barrett. A little modesty and a slight tinge of decency would become Bully Barrett and his satellites while the public is getting ready to learn more about his official acts.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

A telephone line will be constructed between Herndon and Jefferson, Iowa, at once.

J. S. Martin has been granted a telephone franchise at George, Iowa, and will put in a system at once.

The Standard Telephone & Electric company of Madison, Wis., contemplates putting in a telephone system in Marinette, Wis., and Menominee, Mich.

The telephone company at Mount Pleasant, Iowa, is replacing the old-style instruments with modern ones.

The Sunset Telephone & Telegraph company of Seattle, Wash., is renewing and improving its system. The line between Seattle and New Whatcom will nearly all be renewed and improved. The company has connection between Seattle and Spokane, but it is via Portland, making it about 700 miles, while the distance by telegraph is 400 miles. The company contemplates a line of its own across the mountains.

H. P. Blackledge, the new manager for the Iowa Telephone company at Charles City, Iowa, has taken up the work.

Metallic lines are being put in by the telephone company at Iowa City, Iowa.

A. R. Jackson has been granted a franchise for a telephone exchange at Albia, Iowa.

The Perry Telephone company of Perry, Iowa, will make toll connection with Herndon, Iowa, and Coon Rapids, and will put an exchange in the latter place if enough subscribers are secured.

The petition of R. W. Stewart at Dubuque, Iowa, for a telephone franchise brought forth great quantities of eloquence for and against the proposition at the council meeting. E. T. Keim of the Connecticut Telephone company, the projector, presented an alluring view of the matter, guaranteeing that the service should equal the present service and the rates would be ever so much lower and presenting the intent of the new company. John M. Baker of Davenport, Iowa, general manager of the Iowa Telephone company, followed with a somber statement of the woes and troubles involved in starting and operating a telephone exchange and keeping up with the improvements. He affirmed that the Iowa company had the latest appliances and was doing everything it could to improve its service. It made but about six per cent. profit, and on company could make that or any profit at the rates proposed by the new company. He dwelt on the havoc wrought in the finances of those who engaged in the telephone business elsewhere and how unsatisfactory and short-lived they all were. The council voted to consider a franchise to be presented by the new company.

A. T. Presson, who recently secured a franchise for a telephone system at Hudson, Wis., has removed to that place and will prepare to put in the plant. He will use the Standard instrument.

The Boone County Telephone company is preparing to extend its lines in Boone, Ia., and to connect with towns north and south.

The Arcadia Telephone company of Arcadia, Wis., contemplates 300 miles of extensions this season.

R. W. Stewart has been granted a franchise for a telephone exchange at Dubuque, Ia. The Mississippi Valley Telephone Exchange company has made application for a franchise.

Customs Duties on Electrical Apparatus.

The business depression of the last three or four years has not been an unmixed evil to manufacturers of electrical and mechanical appliances, as it has served to emphasize the value of foreign outlets for American goods of this class to many who before were rather indifferent to the possibilities of foreign trade. American manufacturers are now fostering their exports more carefully and intelligently than ever before. The following schedule of the duties on electrical machinery and apparatus in Europe and the United States (published in the British *Board of Trade Journal* for January, 1897, with rates of duty reduced to United States equivalents by the Bureau of Statistics, Department of State) is therefore timely and valuable:

Countries and tariff classification.	Rates of duty.	United States equivalents.
Austria-Hungary:		
Dynamo-electric machines	5 florins per 100 kilograms	$ 1.23 per cwt.
Electric lamps	50 florins per 100 kilograms	12.37 per cwt.
Belgium:		
Dynamo-electric machinery—		
The duties are assimilated to those on machines and machinery of all kinds which are—		
Machinery of cast-iron	2 francs per 100 kilograms	19¼ cents per cwt.
Machinery of wrought-iron or steel	4 francs per 100 kilograms	39 cents per cwt.
Machinery of copper or other metal	12 francs per 100 kilograms	$1.18 per cwt.
Electric lamps	10 per cent. ad valorem	10 per cent. ad valorem.
Bulgaria	10½ per cent. ad valorem	10½ per cent. ad valorem.
Denmark:		
Dynamo-electric machines	0.02½ öre per pund, or 10 per cent. ad valorem, at option of importer.	57 cents per cwt.
Electric lamps	According to material of which composed.	
France:		
Dynamo-electric machines weighing—		
5,000 kilograms and more, containing at least 50 per cent. of cast-iron.	12 francs per 100 kilograms	$ 1.18 per cwt.
5,000 kilograms and more, containing less than 50 per cent. of cast-iron.	20 francs per 100 kilograms	1.99 per cwt.
From 2,000 to 5,000 kilograms, containing at least 50 per cent. of cast-iron.	18 francs per 100 kilograms	1.78 per cwt.
From 2,000 to 5,000 kilograms, containing less than 50 per cent. of cast-iron.	20 francs per 100 kilograms	1.99 per cwt.
From 1,000 to 2,000 kilograms	20 francs per 100 kilograms	1.99 per cwt.
From 50 to 1,000 kilograms	30 francs per 100 kilograms	2.96 per cwt.
From 10 to 50 kilograms	80 francs per 100 kilograms	7.91 per cwt.
Conductors for dynamo-electric machines and detached pieces, such as metal coils, surrounded by insulated copper, worked parts of copper weighing less than one kilogram, numbered and marked, fitted together or not for electric machines weighing—		
More than 2,000 kilograms	35 francs per 100 kilograms	3.47 per cwt.
From 1,000 to 2,000 kilograms	40 francs per 100 kilograms	3.95 per cwt.
From 200 to 1,000 kilograms	45 francs per 100 kilograms	4.44 per cwt.
From 1 to 200 kilograms	60 francs per 100 kilograms	5.94 per cwt.
Less than one kilogram	75 francs per 100 kilograms	7.42 per cwt.
Electric lamps—		
Incandescent lamps of glass—		
With their mountings	350 francs per 100 kilograms	34.60 per cwt.
Not with mountings	700 francs per 100 kilograms	69.22 per cwt.
Arc lamps (regulators)	60 francs per 100 kilograms	5.94 per cwt.
Germany:		
Dynamo-electric machines (so far as they cannot be described as "lokomotiven" or "lokomobilen")—		
Preponderating material being of cast-iron	3 marks per 100 kilograms	37 cents per cwt.
Preponderating material being of wrought-iron	5 marks per 100 kilograms	62 cents per cwt.
Preponderating material being of other common metal	8 marks per 100 kilograms	98½ cents per cwt.
Electric lamps—		
Incandescent (gluh) lamps of glass in conjunction with other materials so far as the same cannot be classed as hardwares, etc., with the exception of cases in which platinum wire is used.	24 marks per 100 kilograms	$2.96 per cwt.
Electric arc (bogen) lamps and other electric lamps	According to material of which composed.	
Greece:		
Dynamo-electric machines	Free	Free.
Electric lamps—		
If of glass	1 drachma per oke	$7.69 per cwt.
If of plain porcelain	50 drachms per 100 okes	3.89 per cwt.
If of porcelain, inlaid, colored or gilt	200 drachmas per 100 okes	15.57 per cwt.
All others	According to material of which made.	
Holland:		
Dynamo-electric machinery	Free	Free.
Electric lamps and appliances for electric lighting not forming part of the machinery.	5 per cent. ad valorem	5 per cent. ad valorem.
Italy:		
Dynamo-electric machines—		
Weighing up to 1,000 kilograms	25 lire per 100 kilograms	$2.47 per cwt.
Weighing more than 1,000 kilograms	16 lire per 100 kilograms	1.58 per cwt.
Detached parts of dynamo-electric machines	25 lire per 100 kilograms	2.47 per cwt.
Electric lamps—		
Of bronze, brass, steel or iron	30 lire per 100 kilograms	2.96 per cwt.
Of other materials	According to material of which made.	
Norway:		
Dynamo-electric machinery	Free	Free.
Electric lamps	According to material of which chiefly made.	
Portugal:		
Electric apparatus and machinery for whatever purpose	30 per cent. ad valorem	30 per cent. ad valorem.
Electric lamps	According to material of which made.	
Roumania:		
Dynamo-electric machines	Free	Free.
Electric lamps	50 lei. per 100 kilograms	$ 4.94½ per cwt.
Russia:		
Dynamo-electric machines of all kinds	1.40 rubles per pood	$ 3.34 per cwt.
Electric lamps	6 rubles per pood	14.34 per cwt.
Spain:		
Dynamo-electric machines	18.50 pesetas per 100 kilograms	$1.82 per cwt.
Electric lamps, chargeable as ordinary lamps according to material of which composed, as follows—		12.17 per cwt.
Of copper	125 pesetas per 100 kilograms	84 cents to $1.73 per cwt.
Of cast-iron	8.50 to 17.50 pesetas per 100 kilograms.	
Of wrought iron	25 to 36 pesetas per 100 kilograms.	$2.96 to 3.57 per cwt.
Of tin plate	50 pesetas per 100 kilograms.	4.95 per cwt.
Of other common metals	37.50 to 45 pesetas per 100 kilograms	3.71 to 4.44 per cwt.
Of glass and crystal	50 to 110 pesetas per 100 kilograms	4.95 to 10.88 per cwt.
Of earthenware	37.50 to 120 pesetas per 100 kilograms.	3.71 to 11.84 per cwt.
Of porcelain	52.50 to 120 pesetas per 100 kilograms.	5.19 to 11.06 per cwt.
Sweden:		
Dynamo-electric machinery	10 per cent. ad valorem	10 per cent. ad valorem.
Electric lamps	1.50 kronor per kilogram	$20.60 per cwt.
Switzerland:		
Dynamo-electric machines	4 francs per 100 kilograms	39 cents per cwt.
Electric lamps	6 francs per 100 kilograms	59 cents per cwt.
Turkey	8 per cent. ad valorem	8 per cent. ad valorem.
United States:		
Dynamo-electric machines	35 per cent. ad valorem	35 per cent. ad valorem.
Electric lamps—		
Of metal	35 per cent. ad valorem	35 per cent. ad valorem.
Of Glass	35 per cent. ad valorem	35 per cent. ad valorem.

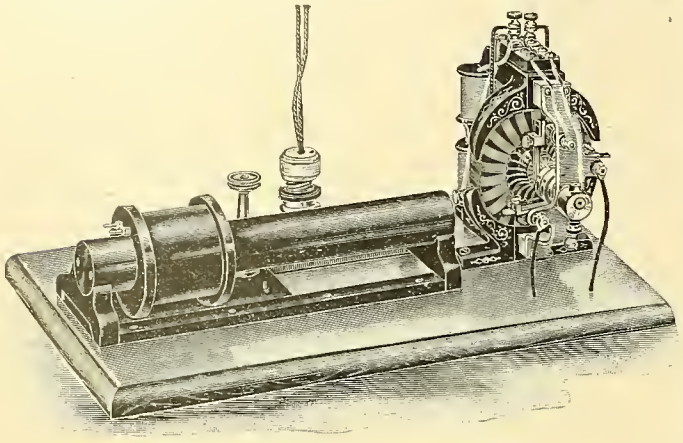
Static Machine for X-ray Work.

E. E. Peirce of Boston advocates the use of static machines for the production of electricity for use in X-ray phenomena. The machine herewith illustrated, which he likes, is a new variation of the old type, made by the L. E. Knott Apparatus company of 14 Ashburton place, Boston. Writing of the availability of static machines for the purpose named, Mr. Peirce says:

"The conditions which long experience has led me to believe must be produced in the exciting apparatus are, in the order named, rapidity of discharge, high potential and low-quantity currents. Without discussing at this writing the manner in which these conditions are met in other forms of exciting apparatus, I wish especially to speak of the latest development of the influence or static machine. The problem heretofore has been to produce a machine which would discharge with sufficient rapidity to give deep penetration. Many experimenters have been using influence machines which would give good definition and in general very satisfactory results on the hand or other thin portions of the body, but were absolutely inadequate for general practical work.

"The limitations surrounding the glass-plate machine are apparent. High speed, of course, is out of the question. Sufficient accumulation for frequent discharge of the condensers can then only be obtained by increasing to a cumbersome extent either the diameter or the number of plates. This fact has led to the use of hard rubber plates which are only so large as is necessary to produce the required length of discharge, and then to increase the accumulation and consequently the rapidity of discharge by speeding to a very high point. When this machine is operated by hand power the speed is obtained by a combined gear and belt. In most of the work, however, the power is obtained by a motor. The design of the machine which is made by the L. E. Knott Apparatus company of Boston is such that either a direct or alternating current motor may be placed on the inside of the case, where the whole is shielded from dust and moisture. This I deem one of the most important points in the construction of a static machine.

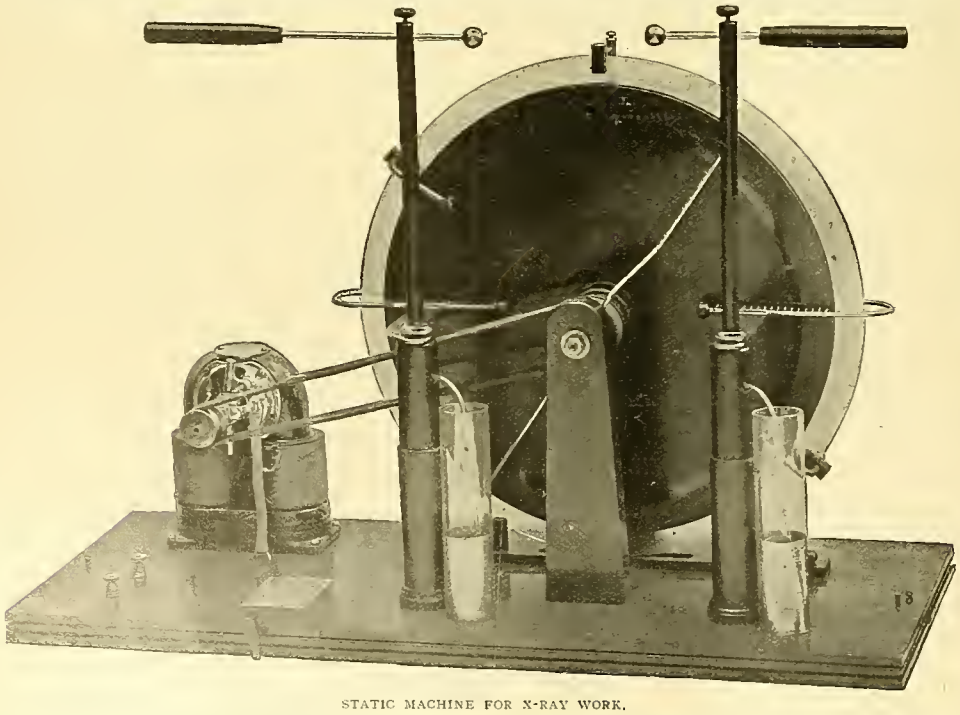
"Having noted in various journals that the reversal of polarity is an unfortunate attribute of the static machine, I wish to state that this seems to have been entirely overcome in the machine which I am using. In short, my machine has never failed to work and has speedily proven itself to be one of the best, if not the best, X-ray generator which has yet been devised."



EDISON DIRECT CURRENT CAUTERY TRANSFORMER.

Edison Direct Current Cautery Transformer.

This apparatus, made for use on 110 to 120 volt direct current circuits, is designed to enable the direct current at 110 to 120 volts to be used with absolute safety for electric cautery work, and it will be found of great assistance to physicians whose offices are equipped with this current. It is also suitable for hospital work. The device consists of a 120 volt Edison motor, the armature shaft of which is provided with two collecting rings, which are connected to the armature at points diametrically opposed. The current taken from these collecting rings, which is now of an alternating character, is led into the primary circuit of the transformer, shown on the left of the cut. The primary circuit is composed of a number of turns of fine insulated copper wire, wound round a core of annealed iron wires, the whole being enclosed in a thin cylindrical shell of hard rubber, which is supported by a hard rubber standard at each end. The secondary coil, composed of a few turns of thick wire, is wound on a hollow hard rubber spool, operated by a rack and pinion movement and sliding over the primary coil. The terminals of the secondary coil are brought out to two pin attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right the current is increased, and vice versa. The apparatus is mounted on a highly polished oak base, and is provided with an attachment plug and 10 feet of flexible cord for connecting the instrument to the mains. This apparatus is manufactured by the Edison Manufacturing company, 110 East Twenty-third street, New York city.

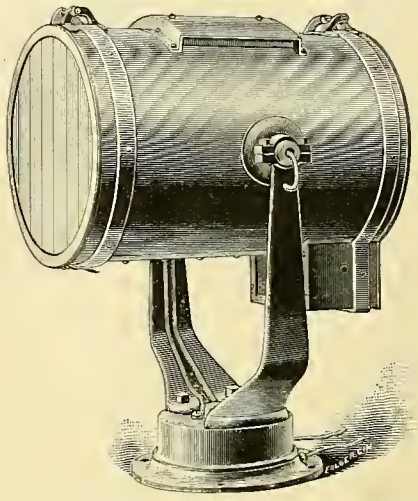


STATIC MACHINE FOR X-RAY WORK.

Catania, Italy, a city of 120,000 population, has on foot two projects for concessions for street railways, and it is more than probable that one will be granted.

Carlisle & Finch's Searchlight.

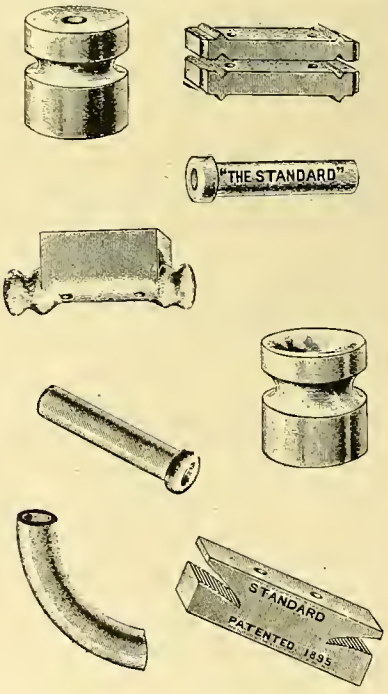
The cut shows the usual form of searchlight projector made by Carlisle & Finch of Cincinnati, O. The lamp is well and substantially made without clumsiness and can be swung horizontally or vertically. The carbons are horizontally placed and the reflector is parabolic. The shape of the beam of light may be easily changed by varying the relative distance between the arc and the reflector. A thumb-screw is provided for this purpose, and a few turns one way or the other will change the light from a straight to a widely divergent ray, and vice-versa. The carbons are fed together by means of a right-and-left screw, and the actuating mechanism is such that the sensitiveness of the lamp is independent of the friction of the moving parts. Thus, the arc will be maintained at the proper length, no matter how dirty and clogged up the moving parts may become. These searchlights are made in sizes ranging in capacity from 2,000 to 10,000 candle power, and all are provided with rheostats for 110 volt circuits unless otherwise ordered. Carlisle & Finch also equip their projectors with mechanical steering gear for turning the lamp (usually placed in the bow when used on river and lake steamers) from the pilot house or other distant point.



CARLISLE & FINCH'S SEARCHLIGHT.

Akron Specialties.

The accompanying cut represents a few of the many specialties manufactured by the Akron Insulator & Marble company of Akron, Ohio, including wiring tubes, insulators and cleats. In the manufacture of this class of goods the company is a pioneer, and its customers are not only sure to get first-class articles but prompt shipments as well. The tubing is manufactured in both the light and dark glaze, while the insulators and cleats are light only. The company makes a specialty of extremely long tubes, which find ready sale.



AKRON SPECIALTIES.

Bates Ceiling Fans.

The ceiling fans here illustrated are from the factory of D. L. Bates & Bro., Dayton, O., and as it is now five years since they have been engaged in the manufacture of these fans, it will scarcely be necessary to say that their experience has enabled them to produce a fan of assured excellence. Fig. 1 shows their latest improved direct current fan, four bladed, with switch attachment. This attachment may be dispensed with if desired and an electrolier attachment of four or five revolving lights substituted, or either of these attachments may be dispensed with. In this case the switch may be attached to the wall. The fan can also be furnished with two blades if desired. The motors contained in the ornamental baskets are wound for 110, 220 or 500 volts direct current. The firm also furnishes this fan mounted on a pedestal if desired. The ornamental work is handsomely finished in nickel, oxidized copper or polished brass. In Fig. 2 is shown the Bates alternating current fan. The firm placed but a limited number of these alternating current fans on the market last season, so as to enable it to detect all the weak points and to make all necessary improvements prior to the fan season of 1897. As these improvements have all been added, the firm now considers this fan perfect. The bearings are all self-oiling. Unlike other alternating current fans on the market, this one is furnished for circuits of high or low frequency and for 50 or 100 volts.

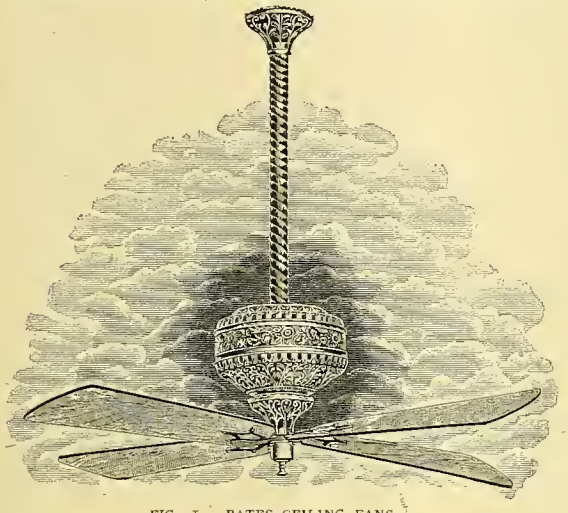


FIG. 1. BATES CEILING FANS.

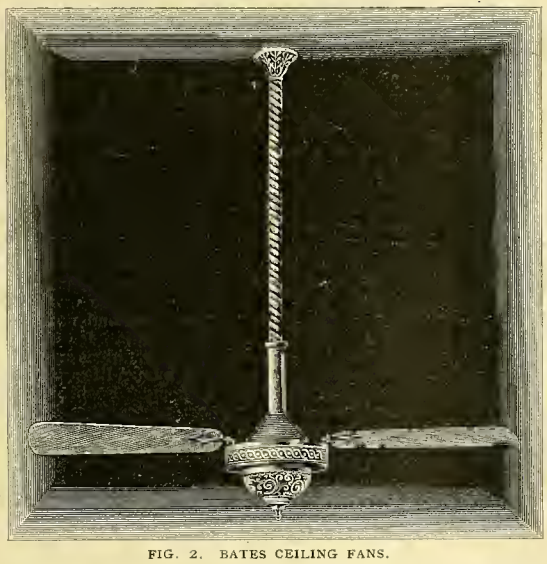


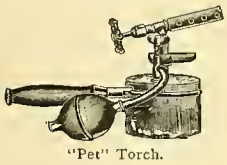
FIG. 2. BATES CEILING FANS.

Berly's Universal Electrical Directory for 1897.

Each year shows an expansion of the field of this excellent work. The present volume, as usual, contains the names of the members of the electrical and kindred industries throughout the world, and the amount of work entailed in its compilation has considerably increased. It has been thoroughly revised and considerably enlarged. The British alphabetical section now comprises about 9,933 names, the continental 6,579, the American 4,472, and the colonial 1,674, making a total of 22,658, approximately 1,146 names of individuals and firms more than were contained in the book for 1896. For simplicity and facility of reference it is divided into four groups, namely: British, continental, American and colonial, which are again sub-divided into alphabetical and classified sections, and in the case of the British a geographical section has been added, making in all nine sub-divisions. In addition to the new names incorporated in the present issue, much financial information is given, the telegraphic addresses and local telephone numbers are given, and the total of pages added to the work is 66 as compared with that of 1896, making in all about 1,020 pages entirely of directory matter. It is, therefore, the largest, as it is the oldest electrical directory in the world. It is published by H. Alabaster, Gatehouse & Co. of London.

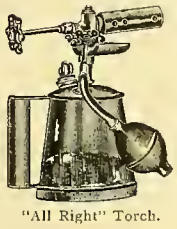
Linemen's Torches.

Four classes or sizes of linemen's torches are shown in the accompanying cuts. The Clayton & Lambert Manufacturing company of Ypsilanti, Mich., which manufactures these torches, has applied to them the titles All Right, Junior, Pet and Twin. All of these torches are fitted with round burners, having powerful generators, which produce an immense amount of pure blue flame that is very intense. Attention is called to the fact that all the needle points are quick opening and are fitted with stuffing boxes, so that no trouble from leaky needles need be feared. The needle points are double shouldered, so that they can be turned tight with little or no wear on the metal, and if after years of wear the orifice is enlarged too much, a few blows with a hammer will close it again ready for use. All parts are interchangeable, so that worn or broken parts may be cheaply obtained.



"Pet" Torch.

"Junior" Torch.



"All Right" Torch.

"Twin" Torch.

LINEMEN'S TORCHES.

Affidavit by Telephone.

[From the *Newark Sunday Call.*]

A bookkeeper for a manufacturing firm over the railroad has a friend uptown who is a notary public, and who has taken his affidavit on several occasions. He called him the other day on the telephone and explained that he wanted an affidavit taken, but was too b usy to leave his office. "If I sign the form—and you knowing signature—will you put your seal to the affidavit?" asked the bookkeeper.

"Certainly," answered the notary, "Take your hat off and raise your hand; have you done so?"

"Hat's off; hand's up," came the response over the 'phone.

"Do you solemnly swear the accounts are correct. etc?" asked the notary. "Send up the paper and I'll stamp it."

Electricity from Carbon Without Heat.

By Willard E. Case.

Part II.

Of course the subject of electricity direct from carbon has been considered from many points of view. Some have attempted to obtain cheap electricity by using the oxygen of the air to oxidize various substances; others have attempted to oxidize coal with the oxygen of the air without heat, and others have attempted to oxidize coal by the oxygen of the air with the application of external heat. The evolution of this subject is most interesting. We will, therefore, study the question from that point of view, and examine some of the most important batteries which have been constructed. We will do so chronologically. Of course lack of time will compel me to avoid reference to many well conceived inventions.

Passing over the carbon-consuming cells of Jablochkoff, Bard, Crumm, Edison, Wright and Thompson, I will first describe the cell invented by C. S. Bradley in co-operation with Prof. F. B. Crocker, which was mentioned in the discussion of a paper read by the speaker on "Electricity from Carbon Without Heat," in 1888, before the American Institute of Electrical Engineers.

Mr. Bradley described fully the action of fused salts on coal and stated that the oxygen of the air was absolutely necessary for the purpose of cheap oxidation or, to use his own language, "The cell consisted of fused sodium manganate, and putting a blast of air through it (and by that means supplying it with oxygen and allowing it to act on the coal, which is put in another part of the vessel) a little over one volt was obtained."

The cell consists of an iron vessel 2½ inches in diameter and six inches deep, which is placed inside of a retort and heated by a gas flame to nearly a red heat. Electrolyte of the cell is caustic soda, to which peroxide of manganese is added, forming sodium manganese. In this cell is immersed the electrode of carbon which acts as the positive pole, and when the circuit is closed you will see that we will have an electromotive force of about one volt with a current of three amperes.

The next cell to which I will ask your attention is that described by W. W. Jacques in *Harper's New Monthly Magazine* in December, 1896, which is another illustration of the same principle involved in the Bradley cell, with a few practical modifications. It, like the other cell, consists of an iron vessel which is the negative electrode, containing fused caustic soda, minus the peroxide of manganese, into which is plunged the positive coal or carbon. The oxygen is supplied by a blast of air, as in the cell before described, and an electromotive force of about one volt is said to be obtained. The difference between these two cells which I particularly desire you to notice, and the only practical difference between them, is the addition of peroxide of manganese to the bath of the Bradley cell; and although I have described them chronologically, I will first show the Jacques cell and then by simply adding peroxide of manganese to it, we will have the Bradley cell. We will then be enabled to get their comparative electromotive force and current in the same cell. But I may say in passing, that experience with these cells leads me to believe that the theory of their action is not by any means well understood. It is most uncertain and erratic, and seems to be more so before than after the addition of the manganese peroxide. Its electromotive force seems to depend upon its temperature. If water is present when the caustic soda is first used, a reverse current becomes manifest. When air is blown through the electrolyte the electromotive force is increased. Sometimes only .3 of a volt is obtained; sometimes about 1½ volts. But the greatest amount of current is apparent when the carbon is immersed in the bath, and, curious to say, the highest electromotive force is obtained when the carbon rod is drawn up along the side surface of the vessel and out of the bath. If the immersed carbon rod is brought in contact with the cold exterior surface of the vessel, no electromotive force is observed. Many other peculiar actions will be noticed if the carbon rod is replaced by an iron one.

When the carbon rod is drawn up along the inside of the vessel the highest electromotive force is obtained, and when this carbon electrode is replaced by another having none of the fused electrolyte on it and brought in contact with the exterior of the vessel, at different points where the temperature varies, no appreciable electromotive force is obtained. This would indicate that as we drew the carbon up out of the bath against the side of the vessel we approach a point where the critical temperature exists and we get the highest electromotive force.

If a nickel crucible be used, as suggested by Bradley some years ago, the electromotive force is brought up to what is considered the theoretical, as you will see. This little nickel crucible contains fused caustic soda and carbon electrode, the same as in the Jacques cell. When heat is applied you will notice that the voltage goes up to 1.16, then begins to fall, and at a critical temperature above a red heat it drops to .3 volt, a most interesting fact, and on cooling the voltage goes up again to 1.16, and drops again when the caustic soda solidifies. You will observe that the voltage is above the theoretical.

With this form of cell it is claimed that as high as 85 per cent. of the energy of the carbon consumed is converted into electrical energy. The following results of tests of the Jacques cell, taken from the article referred to and from the *Engineering Magazine* of July, 1896, may be of interest:

Electricity obtained from one pound of coal (of which 0.4 pound was consumed in the pots and 0.6 was burned on the grate) equaled 1,336 watt-hours, or 32 per cent. of that theoretically obtainable.

Another cell reported in the public prints to have been

built and operated by Jacques consisted of 100 iron cells 1½ inches in diameter and 12 inches deep, which gave an electromotive force of about 90 volts and 16 amperes, supplying 30 16-candle power incandescent lamps for a little over 18 hours. In this experiment it is said that about eight pounds of carbon were consumed in the cells. This, it was stated, gave an efficiency of over 90 per cent., which, of course, did not include the power to operate the air pump and the coal consumed in heating the cells. But my experience with the cells before you leads me to doubt the correctness of these computations.

It has been suggested that carbon-consuming batteries would be too bulky and occupy too much space as compared with that occupied by the present central station for a given output. I find, however, that the Edison station at Duane street has a capacity of 28,000 electric horse power. The cubical capacity of the building is, in round numbers, 900,000 cubic feet. The same building, crowded with Jacques cells, assuming that they could perform the work claimed for them, and leaving aside the question of the difficulty of their operation, properly distributed, would have an output of 60,000 horse power. This estimate is necessarily theoretical and based entirely upon statements made by Mr. Jacques, namely, that a furnace containing cells occupying a cubical space of 600 feet have a capacity of 40 electrical horse power. You will thus see that this ratio is in the proportion of 28 to 60 in favor of the battery.

It has been stated that the electromotive force of the carbon-consuming cells is so low that they would be of no practical value. I think our experience with the storage battery in central stations refutes this idea; at least for potentials up to 250 volts and, by means of rotary transformers, the current can, if necessary, be converted into any form and pressure.

These cells, if correct in theory, can be heated without infringing on the second law of thermo-dynamics, as the law does not apply so long as the oxidation of the carbon itself produces only electricity.

For, as we have said, there is heat in the electrolytes and all matter down to an absolute zero, and the electrolyte in the practical operation of these cells is simply heated to permit the chemical affinities acting.

We are governed here, as elsewhere, by the laws of evolution, and I think that this question will be solved only through many attempts and many failures. I believe that we must look at this subject from a different point. In the first place, can we not learn a lesson from nature? We certainly have a most wonderful example of the conversion of potential energy of carbon directly into work in the animal economy, which is developed at the expense of the oxidization of the material supplied by the food, with an efficiency twice as economical as in the case of the steam engine. One-fifth of the potential energy is converted into work; four-fifths is converted into heat. But we must remember that the human body must be able to exist in the arctic regions as well as in the tropics, that the engine room must always be kept warm, and to insure this average in all parts of the earth and under all conditions, the four-fifths of what apparently is waste energy is necessary to maintain the race.

A day's work of muscular toil is laid down by the authorities at about 1,084,950 foot-pounds. The normal daily expenditure in heat cannot be so readily determined; it is estimated at 6,148,000 foot-pounds; that is, between one-fifth and one-sixth of the potential energy of the food is expended as mechanical labor; the remaining four-fifths or five-sixths leaves the body in the form of heat. Of course, eventually the work goes into heat and is dissipated.

In the human economy the oxygen of the air is taken up by the blood in the lungs. It is carried through the arteries and attacks the tissues, giving up its oxygen and so oxidizing them, and thus producing heat; and when work is done, the equivalent of the heat disappears as work, and when the work is not done the temperature rises, perspiration and evaporation take place, and the temperature is kept at its normal condition through this safety valve. In other words, expressed electrically, there is local action as in a battery. I am aware that the question of the cause of muscular contraction is in dispute, but it is generally admitted that the muscular force must be derived from mechanical energy.[1]

Observe in the first place that nature prepares the food which it consumes to perform its functions. The food is taken into the stomach and digested. A great part of it is useless; the best part is selected and is transformed into a condition in which it can be easily oxidized at a low temperature, the blood acting as the carrier of the oxygen. Does this not give us a hint that we should follow this course likewise, and prepare the material for our carbon-consuming batteries? The oxygen of the air, we always have with us; so have we many carriers of oxygen, but an attempt, so far as I know, has not yet been made along this line which I suggest, except that illuminating and other gases have been used.

A cell which I will soon show you is one described by me in a paper read before the Society of Electrical Engineers in 1887. It consists of two electrodes, one of carbon surrounded by powdered carbon, in a porous cup, and one of platinum, both being immersed in an electrolyte of sulphuric acid in a glass jar about one inch in diameter and six inches in height. Into this electrolyte when we introduce chlorate of potassium we form peroxide of chlorine, which is a very unstable gas and decomposes in the presence of carbon; its oxygen attacking the carbon, oxidizes it without heat, the chlorine being set free at the platinum pole, electricity is generated with an electromotive force of 1.3 volts, varying with the amount of oxidizing agent present and with the kind of carbon used. Or, we can place these two electrodes in a vessel containing water, generating this gas outside the cell and pass it over into the cell containing the electrodes, in which case the cell will operate the same as before, its internal resistance being regulated by the amount of sulphuric acid we may wish to add to the water.

You will notice that when the electrodes are immersed in the sulphuric acid, that only a slight electromotive force is indicated, due to the combination; on the addition of chlorate of potash, the electromotive force is about 1.3 volts per cell and the current about 0.4 of an ampere.

To show you that the action is strong and the oxidation of carbon rapid, I will connect the cell with this little electric bell, which will give you an idea of its strength.

We have been taught to believe that the electromotive force, due to oxidation of carbon, is about 1.05 volts. This value has been arrived at by assuming Andrews' determination, that the oxidation of one pound of carbon to CO_2 equals 14,544 B. T. U., or that one gramme equals 24,944 foot-pounds. This determination was only approximate, and further, it was a determination made at a very high temperature. Now you have seen that the oxidation of carbon in this cell without heat has produced 1 3 volts, and would produce even more if we chose to concentrate the peroxide of chlorine present, which is rather a dangerous operation, as the gas is an explosive one under some conditions. So it would apparently appear that there are more foot-pounds of energy in a pound of carbon than shown by Andrews, unless the additional energy in this instance comes from the peroxide of chlorine.

It might be thought that the high electromotive force obtained in this cell is due to the action of the nascent chlorine on the platinum, but careful measurements have determined the contrary.

We have, therefore, a cell in which carbon is oxidized without the application of heat and at normal temperatures; a cell in which oxygen in unstable composition is readily given up to the carbon and the product of the oxidation is carbonic acid gas, as proved by analysis. I think we have, therefore, the right to assume that a large per cent. of the potential energy of the carbon is converted into electrical energy. The point I wish to make in this connection is: We have in the cell conditions which are analagous to those taking place in the human system, at least to the extent that carbon is and can be oxidized at the normal temperatures in which we live, and its potential energy converted into electricity.

We have in the blood of the human economy a carrier of oxygen called hæmoglobin. It absorbs its oxygen through the lungs, each gramme taking up 1.34 cubic centimeters of oxygen. This oxygen is in such unstable condition that it can be extracted from the blood by means of a vacuum and by means of most reducing agents. It has the power to oxidize carbon and hydrocarbons as the body provides them, without external heat.

We have in this test tube water containing hæmoglobin in solution. You will see by transmitted light it is of the color of arterial blood, as it is fully oxidized, and when a reducing agent is added to it and the air excluded you will see that it becomes the color of venous blood, and when the air is again admitted it takes up the oxygen and becomes arterial in color. This game can be played of give and take and oxidizing and de-oxidizing as many times as we like. Even carbon reduces it and gives it electromotive force.

What I want to express to you is this: In this battery which I have just shown you, carbon is completely oxidized at normal temperature by oxygen which is held in loose combination. So it is done in the human body, and we know that to be a very efficient machine. Therefore I see no reason to think that it is necessary for us to use high temperatures. Keep without the second law of thermo-dynamics. Search for a suitable carrier of oxygen or some cheap source of oxygen supply and hydrogen or carbon, or a carbon compound easily oxidized.

Does it not seem logical that by following along this line and by preparing material to be consumed as nature does in the human body, we may yet be able to reach the desired end with economy? Is it not probable, judging from human experience, that within the wide range of materials, some cheap means can be found? I believe it is. Like all good things in nature, it will come through many trials and failures. The struggle for existence will perfect it, but there is no known law which indicates that we are dealing with the impossible.

In closing, I beg to make my grateful acknowledgment to Mr. Prosser for his valuable assistance and to thank the members of this society for their courteous attention.

1. Proceedings of Royal Society, March 14, 1895.

Discussion.

President Emery: The information contained in the lecture and the manner in which it has been illustrated have been very interesting. I was not aware that we had gotten so far along as we have. These suggestions are valuable, and ought to be carried out along the lines indicated. There is never any harm in following correct principles to the end; those that start off without having the proper foundation fall away.

Mr. Siebold: I ask if it is necessary to keep adding the salt in order to keep up the electromotive force of the cell.

Mr. Case: Yes, sir; in these cases.

Mr. Siebold: Is not that costly salt?

Mr. Case: It is too expensive for practical use. It is simply intended to illustrate the principle that you can oxidize carbon without heat. This battery will oxidize carbon without heat. It gives a low electromotive force; we have oxygen here, in unstable compound, which can be extracted in a vacuum. Here it is in an unstable condition, explosive. The point is to find something between the two.

Mr. Kerr: Have you tried any other substance than the platinum for this electrode? As I understand it, platinum would be very expensive. Have you tried any other metal which will give you a comparatively high electromotive force?

Mr. Case: No, sir; I have not tried any other metal. I do not know of any other metal which would maintain itself under those conditions.

President Emery: Mr. Case has been showing the results of a scientific investigation, and not those which were designed primarily for a commercial success. There is a great difference. All our noted scientists have first worked along scientific lines and achieved certain results independent entirely of commercial application afterward. They have had the higher aim, instead of what we may call the baser one, although the commercial application must in the end follow the scientific investigation. This shows us a direction for investigation, and I am sure all of you will appreciate it for that reason. I am sure there are many present who must be interested in this subject.

C. S. Bradley: Mr. Case has very kindly mentioned a work that I did, beginning in 1882 at the old Pearl street station of the Edison company. The results at that time did not encourage us to go forward. The subject has a great many difficulties which did not seem to occur to Mr. Jacques. The accumulation of the ash from the coal was a very serious matter and will in time clog the battery. Also, after a short time, we found that the electrolyte became hardened. We supposed that it was due to the formation of carbonate of soda. It might have been due to that cause or it might not. We did not have any chemist present and therefore did not analyze the matter. Chemistry has not as yet afforded the means or shown a way, or we have not ingenuity enough to see the way, to find substances which could be readily separated from the ash, and at the same time would not absorb the carbonic acid developed by the carbon in its combustion.

I feel much like an old horse at a three-year-old race, and rather out of it now, in view of all that Mr. Case has done. He has reached rather a bloody end, but I hope that will not be the ultimate end. I feel a little afraid of that peroxide. We may reach that end before we get away from here. Oftentimes a lecturer brings out points which he did not anticipate; and it seems to me that the physician will be largely interested in this subject as it has been demonstrated here. It is a beautiful field of thought—the investigations of the relations of life, its mode of being sustained; and it seems to me like a great step, and a very interesting one, indeed. I have no doubt that some physicians are aware of this principle, but have not followed it from this standpoint. It often depends on the point of view we take of a subject, and this seems a beautiful one, not only from the point of view of producing direct conversion of heat, but it shows how simple human life probably is. It is usually so complex a subject that it is a complete mystery; but if simplified, if each step is seen in all its simplicity, the mystery would in all probability vanish.

C. O. Mailloux: The bloody side of this lecture is to me one of the most interesting that can be shown. It takes me back about 20 years to a time when I was a student at Harvard Medical School, much engrossed in hemoglobin. This substance at that time was principally imposing on account of its name, and not on account of any knowledge we had about it. It was given to us by the professor as a sort of mysterious substance, which has a great deal to do with human life and an important thing in the human economy. I will state for the information of the gentlemen present that I passed the highest in our class in physiology. This statement presupposes that I knew at least as much as anybody about hemoglobin; but I am free to say, after what we have seen and heard here to-night, that what I suspected at that time was true, namely, that I knew nothing about it, and the professor himself did not know much about it. If he were this evening he would open his eyes in astonishment at the intensely scientific and interesting revelation made to us by Mr. Case.

This question is far more significant than it seems to be on the surface. It not only reaches far into the problems of physics, but there is opened a new avenue into the realm of physiology, which is one that ought to be brought to the attention of the medical fraternity, if it has not already been done. The medical man has been for years, ever since my school days, groping for knowledge in regard to hemoglobin and the other constituents of food concerned in the production of energy. We had at that time got so far as to be able by means of a calorimeter to determine the percentage of energy given out by the human body; in other words, we had gotten so far as to determine the efficiency of the human machine, and some of the laboratory work which I did was in that connection; but as to the rational of the conversion of energy we knew absolutely nothing, and while I have long since lost all knowledge of a medical character, I feel this evening as if there had been brought before me a very considerable fund of useful and interesting knowledge.

Another aspect of this important point is the instructive fact, demonstrated to us once more in another manner, the peculiar manner in which energy acts, the peculiarity of energy, that it must be transmuted into one of many forms, and if it does not appear in one form it appears in other forms. I read some years ago in connection with some work relating to batteries, the title of which I do not remember, an interesting hint of an important scientific fact, which is presented by Mr. Case

this evening in its most recent and completed form. This statement showed that in certain given conditions where electricity was concerned, especially in electrochemical reactions, you might have heat or electricity, and that the sum of the two measured the whole energy, so that if it were possible to prevent the formation of heat, you would get your quantum of energy all in the form of electricity; whereas, if it was not possible to do so, it would be in the form of heat. The experiments which Mr. Case has presented to us this evening demonstrate this to be true, and that we are dealing with a problem in which there is an inoate tendency of energy to convert itself into heat, and if we can prevent the conversion of energy into heat we can retain it in the form of electrical energy. It is interesting from that standpoint not only on account of the facts it places in our possession, but on account of the hints it throws out for future research.

PROF. F. B. CROCKER: There were certain technical features brought out by Mr. Case which would bear a little more consideration; one was the use of the nickel crucible. He has found in his experiments just the same facts, I think, as Mr. Jacques has found—that iron exhibits rather a peculiar action, and I believe that Mr. Jacques found it necessary to treat the surfaces in some manner which has not been made public. Apparently, that difficulty has been entirely avoided by the use of nickel, with which you get a higher electromotive force than is possible even under the most favorable circumstances with iron, and you are sure of it. It is constant and reliable. That, of course, from a practical standpoint, is a great step, and would seem to be one of the great difficulties experienced by Mr. Jacques in his work. That advantage of nickel over iron is easily explained, as indicated by Mr. Case. Caustic has very little action on nickel, and that is why nickel crucibles are employed, that they are exempt from action on them by caustics, and in this case, therefore, nickel is the ideal substance to employ. Now, iron, on the other hand, seems to be dissolved more or less when combined with the caustic and produces not only a complicating action, but probably an opposing action. If the negative electrode is dissolved as well as the positive, that would tend to set up a counter electromotive force and interfere with the real action, so that the securing of an inert negative electrode is, in my opinion, an essential element with any successful battery. The use of nickel accomplishes that. It may be that all these peculiar phenomena noticed by Mr. Case are due simply to the action of the caustic on the iron under different circumstances; and I am inclined to think that is the case. The constancy of the nickel crucible is easily explained by this non-action; but we have a phenomenon discovered by Mr. Case in this peculiar dropping off of the electromotive force at a critical heat or temperature, about a red heat, which is not explained by any property of nickel which is known, or any phenomena, chemical or physical, that are recognized. It may possibly be due to the driving off of the oxygen at that temperature from the electrolyte, but that would not explain the fact that the electromotive force comes up again on cooling. It is absolutely an unknown and novel phenomenon, which is very interesting.

MR. CASE: I think the discovery of that is attributable to a certain extent to H. A. Prosser, who was working with me. We noticed the electromotive force drop and thought the circuit was broken. We investigated it and discovered the cause. I think it is entirely new.

MR. SACHS: I would like to inquire regarding the amount of carbon consumption in the experimental cells; whether an experiment has been made as to the consumption of carbon for a certain fixed quantity of electrical output.

MR. CASE: I am sorry to say these experiments have not been made; but I have given directions to have it done this week or next. It never occurred to me that there was any particular use in doing it until I looked into this question a short time ago. Within the last few days I rather thought that question would be asked, and I am sorry I cannot answer it now. I think the economy ought to be pretty high. I do not think there is much local action there. With certain kinds of carbon, with graphite, for instance, the local action is rapid, You put a piece of graphite into that peroxide of chlorine and it combines it immediately and makes graphitic acid, and with carbon it makes CO_2, and does not seem to effect the carbon much unless the circuit is closed. I have had batteries which have been in operation, lying about for a month or two months, and it does not seem to attack the carbon. You cannot judge of it in an offhand way; but that is my impression. I expect to know definitely within a week.

MR. MAILLOUX: Do you ever find any compounds such as melligin, as the result of the action of the chlorine on the carbon, this peculiar combination of carbon, chlorine, hydrogen and oxygen?

MR. CASE: The analysis shows there was chlorine and some free oxygen. The battery was sent by me to a chemist for careful analysis, and that was the report. The chemist also looked for platinum, but did not report finding any. The analyses were made six or eight years ago, and I do not remember the details except that CO_2 was the principal product.

MR. MAILLOUX: It is quite usual to find melligin as as one of the results of chemical reaction where chloride and carbon are combined. The carbon disintegrates and gives rise to a peculiar brownish buttery or almost viscous substance, to which that name has been given. I have a faint suspicion that it contains 10 or 12 molecules of carbon, 11 or 12 of hydrogen, chlorine, etc. It gives rise to a great deal of trouble in connection with all electrolytic processes where the anode is made with carbon compounds. I should imagine it would tend to clog the cell, increase its internal resistance, or introduce other complications.

MR. CASE: I find that different forms of carbon produce different electromotive forces. They all seem to be acted upon differently. Graphite is acted upon and we have graphitic acid; carbon from sugar gave a caramel-like substance and low electromotive force; animal charcoal gave another condition, etc.

PRESIDENT EMERY: Do you recollect what the electromotive force was for graphite?

MR. CASE: Graphite opposed to platinum gave an electromotive force of .7 volt. Different forms of amorphous carbon were substituted in place of graphite. Gas carbon gave an electromotive force of .007 volt when opposed to platinum in sulphuric acid. On the addition of chlorate of potassium the electromotive force equaled .5 volt. Carbon produced by the action of sulphuric acid on cane sugar gave .3 volt. The carbon of animal charcoal, wood charcoal, coke and anthracite coal gave an electromotive force variable with each form, ranging from .3 volt to 1.25 volts.

PRESIDENT EMERY: We have in Rhode Island a coal field, nearly graphite. It has gone beyond the period of hard coal to such an extent that it is hard to use it, and I was wondering whether it was going to be a future source of electricity.

MR. SHERR: As I understand, there is only caustic in that nickel crucible?

MR. CASE: Yes, sir.

MR SHERR: In these other forms of batteries you bubble oxygen through the electrode.

MR. CASE: You would have to do the same in that if it was larger; it is so shallow and exposed to the air that the oxygen is absorbed.

MR. SHERR: It would be more efficient with it?

MR. CASE: The electric current runs up rapidly when you force the air through the battery. I am sorry I did not have a larger cell, replacing the iron with nickel, and we would have had more satisfactory results.

MR. ROME: I saw in one of the electrical papers that Prof. Elihu Thomson says the action of the Jacques cell is never from the heat, and I think Prof. Reed says it is almost entirely from the heat.

MR. CASE: I think it is an open question yet as to whether it is galvanic entirely or thermo-electric; some incline to the idea that it is both. I think Mr. Reed does. Prof. Thomson thinks it is a reducing action in which the oxide of iron is reduced and absorbs more oxygen, which is again reduced by the carbon. I think it is an open question as to how much, to what extent, the action is due to thermo-electricity. The presence of the electrolyte, however, as I show you to-night, is necessary. You can take the carbon without the caustic soda on it, and put it on the outside of the vessel and it will give no current. If you put more oxygen in and blow air through it, the electromotive force runs up and the current runs up. Some say that is due to the chilling effect of the air. Possibly it is; I do not know. We know the carbon is oxidized and burned up and we get the current.

MR. TOKIO: Have you experimented with other forms of carbon, in solution, as it is found in the blood?

MR. CASE: I have tried various forms of oils and hydrocarbons, and tried to make them good conductors.

MR. MAILLOUX: Have you ever gotten results from hemoglobin as an electrolyte?

MR. CASE: Yes, if we put a piece of platinum in here (indicating) you will get an electromotive force from it.

MR. MAILLOUX: How does that compare with the electromotive force obtained between the center of nervous fiber and the periphery?

MR. CASE: It is from half a volt up to one volt.

MR. MAILLOUX. It seems to me that might suggest some idea as to the processes of obtaining electrical energy commercially, by following the methods of developing energy as it occurs in the human body. There is probably something in the tissues that acts in a manner similar to that of dialysis; and if the voltage obtained by your battery is at all similar, we might fairly assume that there was a similarity of conditions.

MR. CASE: This could be done if we could get the right kind of carbons. Experiments with this electric light carbon is different from experiments with animal tissues. There are three schools; one believes that the body is a heat engine, the other that it is an electrical motor, and I do not know just what the third one is.

Zinc Combination.

It is stated that several of the largest zinc-mining companies of the country have combined under the name of the New Jersey Zinc company. The officers of the new company are: Stephen S. Palmer, president; Charles B. Squier, secretary and treasurer; A. Heckscher, general manager. The directors are Stephen S. Palmer, John L. Riker, Moses Taylor Pyne, S. P. Wetherill, A. Heckscher, David B. Jones and Charles B. Squier. August Heckscher, the general manager of the company, in speaking of the consolidation to a *New York Tribune* reporter, said: "Litigation has been pending for many years between the New Jersey Zinc & Iron company and the Lehigh Zinc & Iron company with reference to the ownership of large mines of zinc ore in Sussex county, N. J. The parties in interest have concluded to consolidate their interests, and the consolidation thus effected includes the properties heretofore owned by the New Jersey Zinc & Iron company, the Lehigh Zinc & Iron company, the Florence Zinc company, the Passaic Zinc company and the Mineral Point Zinc company of Wisconsin."

The Duluth, Minn., Street Railway company will equip its cars with electric headlights and fenders.

National Electric Light Association.

Announcement is made by Secretary Porter of the National Electric Light association that the executive committe has decided to hold the next annual convention at Niagara Falls on June 8th. This will be the twentieth meeting of the organization, and the occasion will doubtless be fittingly celebrated.

Following is President Nicholl's interim report No. 3, issued March 5th:

At the close of my last interim report I referred to a meeting of lamp and socket manufacturers that I had called, to be held under the auspices of this association, to discuss the question of standardizing the incandescent lamp socket and lamp base and stated: "Whilst I am doubtful of any direct result toward the desired end from this first meeting, I am hopeful that we can enter the thin end of the wedge, at least, and by sustained and persistent effort accomplish what we have in view."

I now have to advise you that a most successful and well attended meeting was held, accounts of which appeared in the electrical journals at the time, and that at the present good progress is being made, although some unexpected difficulties have arisen to delay a definite settlement. Late in December the National Board of Fire Underwriters, at a meeting held in New York city, amended the rule relating to sockets to read as follows: "No portion of a lamp socket or lamp base, exposed to contact with outside objects, must be allowed to come into electrical contact with either of the conductors."

This amendment to the rules of the fire underwriters makes it necessary that any standard adopted should fulfill these requirements, and I propose calling another meeting at an early date, at which the committee appointed at the last meeting will report progress.

REPORT OF COMMITTEE ON DATA.

The report of this committee has been completed, and after having reviewed same, have no hesitation in saying that it will commend itself to the members of the association as being the most satisfactory report yet issued by this committee. It is now in the printer's hands, and will be ready for distribution some time prior to our next convention, so that members may come prepared to discuss the subject matter of the report and suggest such other features as may appear to them advisable to have incorporated in future reports of this committee.

REPORT OF THE COMMITTEE ON INCANDESCENT LAMP STANDARDS.

Dr. Louis Bell, chairman of this committee, writes me as follows: "Answering yours of January 6th, I am happy to report that your committee has made substantial progress. The matter was taken up with the units and standards committee of the American Institute of Electrical Engineers, as originally planned, and, after much consideration, a final joint meeting was held in New York on December 16th last. At the next meeting of the American Institute of Electrical Engineers' council, this committee on units and standards will lay down its report conjointly with your committee, and we can then proceed to the practical part of the programme. The fundamental question taken up by the National Electric Light association and the American Institute of Electrical Engineers' committees was the establishment of a standard method and apparatus for the measurement of candle power. This has been satisfactorily settled, and it now remains to arrange for the production of secondary standards (i. e., standard incandescent lamps to be used for purposes of comparison), and to draw up specifications for a uniform rating of lamps and its ready verification. It is the opinion of your committee that this reduction to practice of the scientific questions involved would be best accomplished by a conference of your committee with official representatives of the Institute and the lamp manufacturers, so that the final conclusions would carry the joint agreement and assent of these organizations, and an informal conference will soon be held."

PLANS FOR ESTABLISHING A LAMP-TESTING BUREAU.

Most of our members are aware that your association has been endeavoring to promote the standardization of sockets and lamp bases, and the letter of Dr. Louis Bell, published above, shows that your committee has given prompt attention to the important question of standardizing the candle-power of incandescent lamps, and, in this connection, I append hereto a plan for the establishment of a lamp-testing bureau, which has been forwarded to me by a member of our association. I shall be glad if every member will carefully consider these suggestions, and write me as promptly as possible in regard thereto, setting forth his opinion of the merits and demerits of the plan, which follows:

Plans for Establishing a Lamp-testing Bureau, and Suggestions as to Plans Which, if Agreed Upon by Lamp Manufacturers and Central Stations, Would Make the Bureau of Great Value Both to the Manufacturer and Consumer.

The proposed bureau to be in charge of an expert employed by the National Electric Light association, and methods of testing to be approved by a majority of experts of lamp manufacturers, who agree to abide by decisions of the bureau as to quality of product and fulfillment of guarantees.

Any lamp company, whose lamps are being tested at the bureau, will be allowed at any time to investigate the methods used and the accuracy of standards, but to have no access to records of the bureau, except as regards tests which have been, or are being, made on their own product.

The expense of maintaining the testing bureau will be

met by the income of the bureau, as hereinafter provided, by certain definite charges for tests made, and could also probably be partially met by subscription or definite dues from central stations or other consumers, who would signify their intention of availing themselves during any year of the services of the bureau.

Lamp companies would be at liberty to guarantee their product at as high a standard of quality as they see fit, and the province of the bureau would be to determine whether such guarantees have or have not been fulfilled. Tests will be made by the bureau on guaranteed lamps furnished by any manufacturer, on application by the customer, the following conditions having been complied with:

1. Before test is made, the customer ordering the test should deposit with the bureau a sum equal to the estimated cost of such test at the following rates:

Initial tests or readings of lamps will be made at .... cents per lamp. Tests will be made to determine the value of a lamp burned at its marked voltage at .... cents per thousand watt-hours.

Conditions under which tests will be made are as follows:

1 Not less than 20 lamps will be tested to determine the value of any given lot of lamps.

2. Where the value of any lot of lamps is to be determined, not less than two per cent. of the entire number whose value is to be determined are to be furnished the bureau for test in their individual unbroken packages (this would only necessitate the placing of a seal or label on the wrapper of each lamp in such a manner that it must be broken to unwrap the lamp) within 30 days after their receipt by the customer.

Where the number of lamps used in a year by the customer is comparatively small, so that a number of shipments from the manufacturer would be required in order that two per cent. of the entire number should equal 20 lamps, two per cent. of each shipment may be sent to the bureau within 30 days after each shipment, and the test not made or ordered by the customer until 20 lamps have been received by the bureau, provided that such test is ordered within one year from the receipt of the samples from the first shipment.

3. Where tests are requested to determine the value of the lamp by burning it at its marked voltage, an initial test will first be made on lamps furnished, which, as above provided, must represent not less than two per cent. of the lamps the value of which is to be determined. One-half of these, which most nearly represent the average result obtained on the initial test, will be burned at their marked voltage until their value is determined, in accordance with the guarantee. Should any lamp be accidentally broken during the test, its place shall be taken by a reserve lamp, which, on initial test, most nearly represents the broken one. The average result obtained from the test of these samples determines the value of the lamps represented by the samples.

4. The results obtained by tests made by the bureau should, by agreement on the part of lamp manufacturers and of customers who avail themselves of the services of the bureau, be final, claims being settled in accordance with its findings, upon a definite basis agreed upon between manufacturer and customer.

In order that the proposed bureau shall be of value enough to entitle it to the support of lamp companies and their customers, a definite basis of value for a lamp should be determined by agreement between manufacturers and their customers who are to support the bureau. Though lamp companies should be at liberty to guarantee their product at as high a standard of quality as they see fit, the general lines on which such quality is to be determined should be agreed upon by all concerned. The following basis is, therefore, suggested:

1. The effective life of a lamp is to be considered as ending when the lamp reaches some certain percentage of its initial candle-power reading, the value of a lamp being determined by the candle-hours given by burning the lamp at its marked voltage and taking readings of candle-power at intervals of 100 hours, until the candle power falls to .... per cent. of its initial rated candle-power at the marked voltage; or should the lamp tested burn out before reaching .... per cent. of its initial candle-power, it is credited with its actual performance.

Initial readings should be the secondary, and of small value compared to the actual performance of the lamp in service, though manufacturers should guarantee their lamp for individual variation in candle power of not to exceed .... per cent, and an average variation of not to exceed .... per cent. Economy or watts should allow for an average variation of not to exceed .... per cent.

2. The guarantee to the customer should provide that, where the customer requests a test made by the bureau the cost of the test is to be paid, and certain penalties observed, as follows:

If an initial test only is requested, where one or more lamps are found outside the guaranteed initial range as to candle power, the customer is entitled to a .... per cent. reduction in price of lamps represented by the samples furnished the bureau. If average economy is found outside the guaranteed range, the customer is entitled to a .... per cent. reduction. The cost of the above initial test is to be paid by the customer if the lamps are found inside the guarantee, and by the manufacturer if found outside.

Where tests are requested to determine the area, or candle hours, an initial test will first be made on lamps furnished, which, as hereinbefore provided, must represent not less than two per cent. of the lamps, the value of which is to be determined. One-half of these which most nearly represent the average result on initial test will be burned at their marked voltage, and the candle-hours determined.

The average results obtained from the test of these samples determines the value of the lamps represented by the samples. Should the average candle-hours, or area, fall below the guarantee not more than .... per cent. the manufacturer shall only pay the cost of the test. Should the candle-hours, or area, fall more than .... per cent. and less than .... per cent. below the guarantee, the customer is entitled to a .... per cent. reduction in price of lamps represented by the lamps tested, and the manufacturer to pay the cost of the test. Should the average candle-hours, or area, fall below the guarantee by more than .... per cent. and less than .... per cent., the customer is entitled to a .... per cent. reduction in price of lamps, and the manufacturer to pay the cost of the test.

The above percentage of reduction, or penalty, to be continued in proportion until the customer obtains the lamps (no charge), the manufacturer paying the cost of the test.

Should the average candle-hours, or area, be at or above the guarantee, the customer shall pay the cost of the test.

As above provided, where tests are requested by the customer, check should be sent to the bureau before the test is made, covering the estimated cost of the test.

Although not an important point, I believe it would greatly stimulate advance in quality of lamps, to the benefit of both consumer and reputable manufacturers, if every six months the average results of all tests made on the product of different manufacturers were published in the electrical journals, such results to separate various economies, and placing in different classes lamps of voltages from 45 to 60 volts, and lamps from 100 to 125 volts; also separate results on any test which might be made on lamps from 200 to 250 volts.

PAPERS TO BE READ AT THE CONVENTION.

I am happy to be able to submit the following list of papers to be read at the convention, and the names of the authors are a guarantee that the papers to be read will be of a high order of merit. Some of the manuscript is already in the hands of the secretary, and, depending upon the assurance of the authors that their manuscript will be forwarded at an early date, it is expected that printed copies of each of the papers will be furnished members a reasonable time before the date of the convention:

W. Worth Bean, St. Joseph & Fort Benton Railway & Lighting company, "Municipal Lighting."

J. B. Cahoon, Elmira Municipal Improvement company, "Standardizing Prices for Incandescent Light and Power."

C. L. Edgar, Boston Edison company, "Correct Method for Charging for Product."

W. S. Jewell, Toledo Traction company, "Cost of Delivery of Current from Station to Customer."

T. C. Martin, editor *Electrical Engineer*, "The Daylight Work of Central Stations."

L. B. Stilwell, Cataract Construction company, "Electrical Development at Niagara."

Professor Elihu Thomson, Lynn, Mass., "Recent Progress in Arc Lighting."

J. G. White, White-Crosby company, "The Niagara Power Transmission Line."

Professor Wilson, Electrical Engineering Department, McGill University, Montreal, and Chas. A. Carus, member Institute Electrical Engineers, New York and London, "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

Arthur Wright, president Municipal Electrical Association, England, "The Profitable Extension of Central Stations."

CORRESPONDENCE.

New York Notes.

NEW YORK, March 6.—Details of the terminal arrangements for the electric cars on Brooklyn Bridge are given by one of the daily papers, which has to admit that "the trolley is coming to Manhattan Island, although strenuous efforts have been made to prevent it." This terrible event will take place when the Brooklyn trolley cars are allowed to run over the bridge, as it is expected they will be when the bridge trustees make up their minds on the proposition now before them. Some people, it is stated, have been wondering whether, when the Brooklyn cars cross the river, they will not seriously obstruct the entrances to the bridge station, since they will have to make a loop in passing from one roadway to the other. As at times there will be almost a continuous line of cars, there is no doubt that they would prove a formidable obstruction if they were to run on the surface of the roadways and pass through the first floor of the station. But nothing of that kind has been contemplated by the bridge trustees or by the experts employed to determine the feasibility of operating elevated and surface cars on the bridge. The plan is to have the trolley cars leave the north roadway some distance east of the station, and run on an ascending grade outside of the roadway, and then over it, until they are nearly at the level of the present railroad tracks in the station. The trolley tracks will then encircle the station, passing at its western end clear above the elevated station and the switching tracks. On the south side they will descend to the same height as on the north, and finally will reach the level of the south roadway opposite the point where they left the other. A number of sidings will be provided on both sides of the station, at which the cars will be halted for discharging and receiving passengers, and special stairways from the gallery floor of the station will be provided for trolley car passengers. The plan does not involve any encroachment on private property, as the proposed additional structures will all be on bridge land, except the loop, which will extend over Park Row. The present station building will not be materially altered, although extensions will be erected along the sides. The trolley cars are expected to run at a speed of seven miles an hour in crossing the bridge. The speed of the cable cars is a little more than 10 miles an hour. As the distance is about a mile and one-seventh, perhaps four minutes' time will be gained by using the regular trains; and, whichever way one travels, about the same amount of stair-climbing will be required at the New York terminus. In Brooklyn, however, the trolley cars will run in and out on the street level. It is the intention of the trolley companies to carry their passengers across the bridge without any charge beyond the five-cent fare, while arrangements will be made for passengers by the regular cars to pay the usual bridge fare of 2½ cents.

At the recent Stevens Institute celebration President Morton drew attention to the need of a larger revenue as essential for an adequate future development of the work which had been so successfully carried on heretofore. He presented on the same occasion to the trustees some shares of stock likely to appreciate as the year progressed. This suggestion has been acted upon by Mrs. E. A. Stevens, widow of the founder of the institute, who has transferred to the trustees two large lots and houses directly adjacent to the institute grounds, which, while having at present a valuation of about $30,000, have a prospective value much greater.

From Albany comes news that the finance committee of the state Senate has reported favorably a bill directing George W. Aldridge, the superintendent of public works, to provide a lighting plant to furnish light for the state buildings in Albany, which is to be done in connection with the completion of the capitol.

Another trolley railway accident due to lack of efficient train-dispatching is reported. It was a "head on" collision on Wednesday morning between cars on the electric railway that connects Fort Lee and Englewood. Several persons were injured. It is a single-track road, and two cars going in opposite directions met in the fog, with the result to be expected. With a competent system of dispatching trains the accident could not have happened. M. S.

Washington, D. C.

WASHINGTON, March 6.—The electrical decorations of the ball room in the Pension building for the inaugural ball were highly complimented by both the committee and the visitors. Relays of workmen were engaged for two weeks night and day. Over each of the three divisions of the court made by the famous big pillars, large coronas, studded by hundreds of electric lights were suspended. John R. Galloway of Washington had the contract for putting in place the electric lights. There were 8,700 ground glass incandescent lights and 50 arc lights used in the room. On each of the 148 iron pillars supporting the balconies of the court were placed 16 lights over a jacketing of yellow and white challie—a sort of "16 to 1" arrangement. At the west end of the court, up above the second balcony, hung a large national flag, composed of red, white and blue incandescent lamps, which by a switching arrangement gave the effect of the waving of the genuine bunting. On the south side of the court above the band balcony was an electric decoration with the names "McKinley and Hobart" on streamers in electric lamps, surmounted by a shield of red, white and blue, topped by the American eagle, all in lamps. At the east end of the court was perhaps the most pleasing feature of the whole conception. A large balcony was constructed, reaching 50 feet out into the court, to accommodate the orchestra. This was beautifully draped in yellow and white, and a large, deep arch was constructed entirely of yellow and studded with electric lights.

The electrical display on the building at Thirteenth street and Pennsylvania avenue eclipsed anything in that line for inauguration week. The beautifully arranged lights attracted attention squares away, and a

more lavish use of electricity for decorative purposes has been seldom seen. It was prepared regardless of expense by order of R. T. Warwick, one of the tenants of the building. T. I. P.

PERSONAL.

Lyman J. Gage, the new secretary of the treasury, is a stockholder in the Chicago Edison company.

H. H. Vreeland, president of the Metropolitan Traction company of New York, has been elected director of the Long Island Railroad company.

Among the prominent Chicagoans who attended the inauguration of President McKinley last week and upon invitation remained in Washington to witness the installation of Lyman J. Gage into the office of secretary of the treasury, was Samuel Insull, president of the Chicago Edison company.

F. S. Marr, Philadelphia, Pa.; T. H. Brady, New Britain, Conn.; T. Bibber, Boston, Mass.; F. P. Kennedy, Fulton, N. Y.; A. J. Smith, Cleveland, Ohio; J. H. Reid, Pittsburg, Pa.; H. B. Cutter, Philadelphia, Pa., and E. L. Babcock, Cuyahoga Falls, Ohio, registered last week at the headquarters of the National Electric Light association, New York.

The Prince of Wales, president of the British Society of Arts, presented to Professor D. E. Hughes, F. R. S., at Marlborough House, on February 16th, the Albert medal, awarded him by the council of the society "in recognition of the services he had rendered to arts, manufactures and commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and microphone."

ELECTRIC LIGHTING.

Ogden avenue (Chicago) between Madison and Twelfth streets is to be lighted by electricity. Assistant Commissioner of Public Works Moody has advertised for bids for the work. Fifty arc lights will be required. The work will be paid for by special assessment. This is said to be the first instance in the city's history where the electric lighting of a street has been paid for in that way.

Bids were opened March 1st for the sale of electric light bonds issued by the village of Bluffton, O., to the amount of $8,000, bearing interest at six per cent. from March 1st, maturing in sums of $500 yearly, commencing with 1900. The successful bidders were N. W. Harris & Co., Chicago, their premium being $722 50. Plans and specifications have been prepared and accepted by the council, and bids for the plant will be opened April 1st.

TRADE NEWS.

The Orne Electric Construction company of Chicago has just completed the electrical work in the new United States branch postoffice located at the corner of Canal and Jackson streets, Chicago. This, next to the main office, is the largest postoffice in Chicago. All the fixtures are of special design, and the entire plant was furnished and completed in 20 days.

The new multipolar Churchward dynamos and motors for both direct and alternating current, manufactured by the Excelsior Electric company of 115 Broadway, New York, are described in a recent pamphlet. Slow speed, sparkless commutation and low heat limit are features claimed. The same company issues sheetlets clearly describing its arc machines and arc lamps. R. J. Randolph is the well-known manager of the Chicago office.

Daniel Hemingray of the Hemingray Glass company of Covington, Ky., expresses himself as much pleased with the prospects for business. "Present business, too," says Mr. Hemingray, "with us is exceptionally good. They talk of more or less dullness in trade, but I can't say we feel it." As Mr. Hemingray is noted for his energetic and aggressive methods and for never letting the grass grow under his feet, it is not strange that his establishment is kept busy.

The National Electric company of 15 Michigan street, Cleveland, O., announces the opening of its establishment for repair work and as an exchange for second-hand electrical apparatus. The members of the firm and the workmen are all said to be electrical men who have been practically connected with the construction and repairing of electrical apparatus for a number of years, and it is guaranteed that the work will be put up with the greatest care.

The American Rheostat company of Milwaukee has secured the services of F. E. Herdman as general manager. Mr. Herdman was until recently with the Crane Elevator company of Chicago, and his ability as an electrical engineer is well known. The American Rheostat company is also moving into quarters considerably larger than those formerly occupied, in order to keep up with the demand for its output. It is about to place on the market a complete and improved line of elevator controllers, automatic pump starters, etc.

The removal of the headquarters of the American Electric Telephone company from Kokomo to Chicago will undoubtedly prove greatly beneficial to the interests of the company. Having recently secured the services of H. C. Dodge, so well known through his aggressive efforts for the Standard Telephone & Electric company of Madison, Wis., as general manager of the company, the business cannot but prosper. Mr. Dodge is a thoroughly experienced telephone man in every respect, both technically and from a business standpoint. His work for the Madison company is well known, and as he is now with a man of such recognized ability in the telephone field as P. C. Burns, the friends of the organization anticipate great things in the line of the company's spring business.

Carlisle & Finch, Cincinnati, O., manufacturers of electrical novelties, report that they have sold several thousands of the various electrical toys manufactured by them, and that they have been compelled to run their factory night and day to keep up with the demand. The firm contemplates the production of other electrical novelties, such as boats, fountains, pumps, etc., also larger electric cars to run on straight track. Among the other manufactures of this concern may be mentioned focusing lamps and searchlights for all purposes, also locomotive electric headlight apparatus. Perfection in design and workmanship characterize all of the goods turned out by this firm.

In the disastrous fire which entirely destroyed the principal power house of the Union Traction company, Philadelphia, on the night of March 3d, there were a number of I-T-E circuit breakers, as well as circuit breakers of other makes and types. While the engines were still playing upon the flames, Charles Hewitt, chief electrician of the Union Traction company, placed himself in communication with the Cutter Electrical & Manufacturing company of Philadelphia and ordered, for immediate delivery, 165 I-T-E circuit breakers. This order was provisional upon prompt delivery, as required by the Traction company. Inside of 24 hours 116 of these circuit breakers were delivered to the Traction company. It would seem that comment upon the merits of the I-T-E circuit breaker, and the size of the Cutter company's business, which would enable it to fill this order (one of the largest ever placed at one time for circuit breakers) is unnecessary. The fact that standard switchboard types were ordered made it possible for the entire order, practically, to be filled out of stock.

The Bullock Electric Manufacturing company is the name of the company heretofore known as the Card Electric Motor & Dynamo company, Cincinnati, Ohio. George Bullock is president and treasurer, and J. S. Neave vice-president and secretary of the new company. Both gentlemen have long held similar positions with the Card company. The excellent reputation of the apparatus manufactured by this company under its former title will assure the favorable reception of the new goods to be put on the market this season. Another concern, the Bullock Electric company, in which Mr. Bullock and General Eastern Agent Robert T. Lozier are partners, has been organized to handle the sales department of the Bullock Electric Manufacturing company east of the Alleghanies. It is located in a handsome suite of offices in the new St. Paul building, New York city. The company will also have branch offices in Boston and Philadelphia. The western representative of the Bullock Electric Manufacturing company is A. Shillinglaw, with offices at 623 Western Union building, Chicago. Other agents are the following-named: St. Louis Electrical Supply company, St. Louis; Wood & Speed, Louisville, Ky.; Thomas H. Smith, Denver, Colo.; E. Darrow, Spokane, Wash., and Bergtheil & Young, London, England.

BUSINESS.

The Ohio Brass company of Mansfield, Ohio, announces a full line of motor repair parts, car appliances and supply parts for the equipping of summer electric railway cars. The company has a complete stock of electric railway supplies and makes prompt shipments.

The Shawmut Fuse Wire company of 93 Federal street, Boston, says of its new patented 500 volt quick-break switch that it is the only one on the market meeting the new specifications of the city of Boston, and the only one approved by the underwriters of New England.

Every mechanic and manufacturer is interested in anti-friction bearings, and in consequence the pamphlet of the Ball Bearing company of Boston, describing its ball and roller bearings for machine construction and line shafting, is of wide interest. The little book gives a list of customers and flattering testimonials.

The celebrated Hornsby-Akroyd oil engine is made in the United States by the De La Vergne Refrigerating Machine company of New York. This is a very well-known engine, and several thousand are in successful operation in all parts of the world. The De La Vergne company will send information on application.

The owner of the Paul O. Stensland building of Chicago has increased the electric plant by the addition of a direct-connected engine and dynamo, the engine being furnished by the Ball Engine company, Erie, Pa., and the dynamo by the Jenny Electric company, Indianapolis. This is the third direct-connected outfit furnished by the same companies in this building.

The Burt Manufacturing company of Akron, Ohio, claims to be the largest manufacturer of oil filters in the world. Its Cross filter is highly spoken of, and a little book of testimonials from prominent users is issued to present fac-similes of commendatory letters. It is said that this filter is used in every state in the Union and in Canada, England, Russia, China, Japan, South Africa, Australia, India and South America.

The Electric Appliance company is just distributing to the trade a catalogue describing a complete line of Anchor snap switches. This is probably the most complete catalogue of snap switches that has been published, and includes a number of new applications of the snap switch; also a complete line of dial or indicating switches. The Electric Appliance company has prepared a special trade discount sheet for this catalogue, which quotes up-to-date prices on the goods listed. It will be glad to receive inquiries for the catalogue.

Friends of E. L. French, until recently electrical engineer and superintendent of the Missouri Telephone Manufacturing company, St. Louis, will be interested to know that he has accepted a position with the American Electric Telephone company of Kokomo, Ind. As this company, however, has recently opened a Chicago office, Mr. French's headquarters will be in Chicago. Mr. French has had an extensive experience, and his extended knowledge of the telephone business, to say nothing of his host of friends, will undoubtedly prove a valuable acquisition to the American company. Mr. French combines a technical experience with social qualities that fit him to make success as a man of business.

A full line of direct current dynamos and motors for electric lighting and power transmission is shown by the Crescent Electric Machine company of 643–647 Kent avenue, Brooklyn, in its new catalogue. The machines are generously proportioned and substantially constructed and adapted to withstand severe service. For generators smaller than 10 kilowatts and for motors below 20 horse power moderate speed the company uses a two-pole type of machine, and the larger generators and motors are of the four-pole type. It also makes four-pole motors of 15 horse power capacity for customers who require this style. The generators are built for direct or belt connection. Users speak in flattering terms of these machines.

The Bossert Electric Construction company of Utica, N. Y., has so much work that it is about to build a new and much larger plant. The company established itself at 40 Broadway and put in heavy machinery. So popular has its product proved that it is now obliged to enlarge its plant. The company manufactures its well-known wall outlet and switch boxes and also steel-clad, slate lined panel and junction boxes and switchboard. The great merit of these boxes lies in the fact that they are drawn out of steel and are therefore an improvement over boxes of cast-iron, although they are made more rapidly. They are covered by patents. The new plant will consist of four buildings, and the company will be enabled to largely increase its output.

The Metropolitan Electric company of Chicago has been given the western agency for the full line of adjustable incandescent lamp holders made by White & Co. of Worcester, Mass. These holders are especially adapted for factory, mill and machine-shop work, where the operator must have good light. They are simple in construction, strong and durable, and do their work perfectly; are made in various forms, to suit all classes of work. They allow the lamp to be shifted, and no attention need be paid to the fastenings or joints, as they are constructed so as to be adjustable to every conceivable position. R. Hoe & Co., New York; Washburn & Moen Manufacturing company, Worcester; Westinghouse Machine company, Pittsburg, and the Wagner Palace Car company are among the users of these holders.

A representative of the WESTERN ELECTRICIAN recently visited Sandusky, O., and called at the works of the Partridge Carbon company. He found this concern busy filling orders. This institution is eminently fitted to turn out the highest class carbon goods and to do this in every way to the benefit of the consumer. Mr. Partridge, after whom the concern is named, is one of the oldest carbon manufacturers in this country; and foreigners, too, can testify to his high degree of skill in the art. In fact it has been said if "Partridge can't make a carbon no one can." With Mr. Partridge, therefore, at the technical and manufacturing end of the concern, and at the helm of the business end a man as energetic and aggressive as Manager J. S. Speer, it is no wonder that the Partridge company has built up such a fine business. The brush of the Partridge company has peculiar merits and is one now thoroughly appreciated by the largest railways in this country.

The American Electric Telephone company, according to all reports, is doing a most satisfactory business and one over which it should feel great satisfaction. General Manager H. C. Dodge, who until recently was manager of the Standard Telephone company of Madison, Wis., has recently allied himself with President P. C. Burns of the American company, and there has also been an acquisition to the company's staff of skilled men in the person of E. L. French, who, until accepting this position, was electrical engineer and superintendent of the Missouri Telephone Manufacturing company of St. Louis. The general offices of the American Telephone company are now in the Springer building, 171–173 South Canal street, Chicago. The main factory of the company is located in Chicago, also in the Springer building, but a branch factory is still busy at Kokomo. The Kokomo branch, which is the original factory, will continue to be run at Kokomo; in fact, the Chicago factory is practically an extension of the company's manufacturing plant. President P. C. Burns will have his headquarters at the Chicago office. It is not finally decided, but the company will, in all probability, take a suite of offices somewhere in the neighborhood of the Postoffice Square, Chicago, in order to facilitate business. In these offices in all probability will be a full line of telephone apparatus for exhibition purposes. Paul Bossart, who has been identified with the company for the last year and a half, will be installed as secretary under the new arrangements, with headquarters at the Chicago city office.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued March 2, 1897.

577,853. Trolley Pole Controller. Louis M. Halsey, Brooklyn, N. Y. Application filed July 20, 1896.

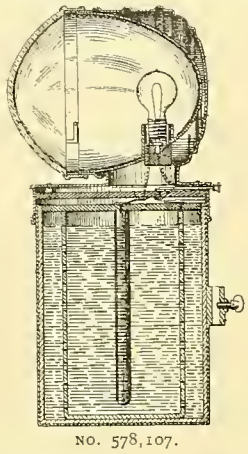
The trolley pole, jaws and trolley wheel therein, with the shaft having the shoulders, the rods and heads matching to the shoulders the loop on one of the heads and the lip on the other, and a supporting spring for each.

577,864. Alternating Current Arc Lamp. Edward R. Knowles, Brooklyn, N. Y. Application filed August 19, 1896.

An arc-starting mechanism for alternating current arc lamps employs means for holding the carbons in contact for a sufficient time to heat the carbons to maintain the normal arc, with means for thereafter slowly separating the carbons to establish the arc.

577,872. Electrical Car Lighting. Morris Moskowitz, Newark, N. J. Application filed December 23, 1896.

On a car-wheel axle and truck frame a dynamo is placed with a pulley wheel on the car-wheel axle, a bracket on the frame, a swinging bearing plate on the bracket, a shaft, a pulley wheel on the shaft, and a belt passing over the upper surface of the pulley wheel on the car-wheel axle, the pulley wheel on the car-wheel axle being adapted to be removed without moving the belt.



NO. 578,107.

577,885. Electric Railway. Courtland Skinner, Chicago, Ill. Application filed May 27, 1895.

There is the combination with a normally insulated underground wire, a car, a motor carried thereby and collector therefor, of a normally depressed and insulated circuit-closing bolt movable bodily, vertically, and consisting of a central metallic bolt, and insulating material covering the same between its exposed ends, the bolt when raised by the collector closing the circuit between the wire and a motor.

577,911. Automatic Telephone Call Device. Edward P. Boland, New York, N. Y. Application filed April 6, 1896.

An automatic device comprising a box or casing is described, in which is placed a passage for coin, a pivotally supported receptacle which is adapted to receive the coin and to eject the same, a spring onto which the coin is adapted to roll, and another spring with which the first named spring is adapted to be brought in contact by the coin, and a battery or other suitable source of electrical supply which is in circuit with the springs and the central station.

577,912. Electric Railway. Samuel G. Brosius, Baltimore, Md., and William B. Upton and Joseph Colvin, Washington, D. C. Application filed February 25, 1896.

A car is provided with a propelling motor, positive and negative conductor rails for the electric current, a plow connected to the car adapted to carry the electric current to and from the motor for propelling the car, and provided on each side with a shoe adapted to move in contact with the conductor rails, and insulated shoe boxes in which the shoes are located.

577,920. Telephone Call Register. William A. Heckard and Dora Ogden, Columbus, Ind. Application filed June 8, 1896.

A shaft forms part of an open electric circuit; a series of contact wheels is secured to the shaft, each of the contact wheels being provided with a series of contact points; a terminal also forms a part of the open circuit; means are provided for causing the terminal to engage with the series of contact-points upon anyone of the contact wheels; an electric motor is connected with the shaft; a terminal forms a part of the open motor circuit; a lever also forms a part of the motor circuit, while there are means operated by the movement of the first-mentioned terminal for causing the lever to engage the last-mentioned terminal, and thereby close the motor circuit, a cam secured to the shaft and adapted to engage the lever, the cam operating during a portion of its revolution to hold the motor circuit closed, and also operating to open the motor circuit.

577,921. Trolley Catcher. Thomas Holahan, Rochester, N. Y. Application filed July 11, 1896.

The combination, with the trolley arm, of a section hinged thereto to turn upward, a spring for forcing the same upward, and two cords connected at one end to a pendant of the hinged section, and at the other end one with a winding apparatus for drawing the trolley down, and the other with a disengaging device that operates the locking devices of the winding apparatus.

577,949. Danger Signal. Daniel A. Gordon and Benjamin B. Weir, Cassopolis, Mich. Application filed August 29, 1895.

The chief features are the track-supporting framework, the movable suspended signals, the electric circuit including an alarm and the signal-operating mechanism, a circuit break in the circuit and a lever mounted in the framework and connected with the circuit-break.

577,950. Double Pole Reversing Snap Switch. Hermann A. Goro, New York, N. Y. Application filed August 6, 1894.

Oppositely arranged removable plates support circuit terminals and intermediate contact blocks, with insulating material interposed between the contact blocks.

578,006. Table Telephone Apparatus. Lars M. Ericsson, Stockholm, Sweden. Application filed October 27, 1896.

One claim is for the combination of the rotary core, the pole-pieces and the magnets of horseshoe shape extending downwardly from opposite ends of the pole-pieces to form the supporting feet.

578,016. Commutator Brush. Jesse F. Kester and Fisher C. Atherton, Buffalo, N. Y. Application filed June 16, 1896.

A corrugated core and a wire gauze covering surrounding the core.

578,069. Electric Motor. Harry A. Stock, Millersburg, Pa. Application filed April 15, 1896.

This is an alternating current motor, all of whose field poles are at any instant of the same sign, in combination with two sets of armature poles which at any given instant are of opposite signs, and coils wound on all of the poles connected to a source of alternating current.

578,070. Electrode. Albert E. Woolf, New York, N. Y. Application filed January 13, 1896.

An electrode for electrolysis of saline solutions is described, consisting of an exposed thin plate of metal or metals of the platinum group, the plate being comparatively long from end to end, and narrow from its inner attached edge to its outer free edge, a connected conducting plate of base metal, the platinum compound plate being attached at its long edge to a similar edge of the conducting plate, and having a long free edge and a coating of insulating material applied to the surface of the conducting plate to the joint at the attached edges of the plate and to the ends of the platinum plate to prevent the corrosive action of gases and give greater strength and rigidity to the electrode.

578,077. Testing Apparatus for Electric Automatic Systems. Charles Burgher, Newton, Mass. Application filed December 17, 1896.

Principal parts of this mechanism are a recording surface, a stylus or marking device co-operating therewith, an electro-magnet to operate the stylus, a plurality of circuit controllers normally closed and forming part of the circuits to be tested, a circuit-terminal co-operating with the movable members of the circuit controllers, an electro-magnet connected in circuit with the terminal and governing the operation of the registering magnet, and means to operate the movable members of the circuit controllers.

578,079. Convertible Signal Lamp. Charles H. Dressel, New York, N. Y. Application filed June 20, 1895.

The combination of the lamp body having at its top a ring surrounding an opening into the lamp body and formed with perforations in its lower part, such ring being constructed to serve as a supporting-bearing above such perforations, and a removable and replaceable closing cap carrying an electric lamp adapted to fit and be supported upon the bearing portion of the ring.

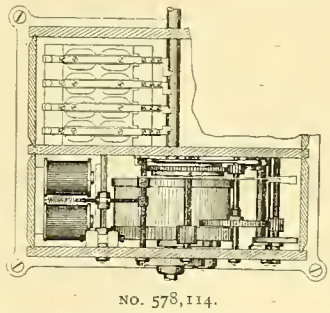
578,107. Electric Lamp. Milton M. Kohn, Chicago, Ill. Application filed December 4, 1895.

In an electric lamp there is the combination, with a case to contain a battery, of a cap detachably fitted over the top of the case, contact-pieces connected to the positive and negative elements, and mounted upon an insulating plate which forms a seal for the battery, contacts mounted upon the detachable cap and electrically engaged with the contacts upon the seal-plate when the cap is fitted upon the case, and a hand-operated switch pivoted upon the cap to cut the lamp into and out of circuit.

578,113. Message Recording Instrument. Bernice J. Noyes, Boston, Mass. Application filed June 25, 1896.

In a message recording instrument adapted to be connected with and operated by several signaling circuits there is the combination of time-printing indicators and a platen, a paper-feeding device for feeding a strip of paper between them, electro-magnetically operated marking devices, one for each circuit connected with the instrument located close to the time-printing indicators for recording a message on the moving strip of paper, a motor mechanism for operating the paper-feeding device, a starting magnet for releasing it common to all the circuits, a cam secured to one of the shafts of said motor mechanism, and a lever actuated by it bearing the platen.

578,114. Electric Signaling Apparatus. Bernice J. Noyes, Boston, Mass. Application filed July 11, 1896.



NO. 578,114.

This arrangement includes a main signaling circuit, signal transmitting devices for operating the circuit adapted to transmit a differentiating impulse with some signals and not others, and a signal receiving instrument for receiving all the signals, combined with an auxiliary circuit, a signal receiving instrument operated by it, an automatic switch for controlling the operative condition of the auxiliary circuit; means for operating the switch controlled by the differentiating impulses, a restoring device for the switch, and means for operating the auxiliary circuit operated by the main signaling circuit.

578,115. Electric Signaling Apparatus. Bernice J. Noyes, Boston, Mass. Application filed July 21, 1896.

There are a number of main signaling circuits, signal transmitting devices for operating them adapted to transmit signal impulses of short and long duration, and a message recording instrument for receiving all the circuits having a paper-moving train and paper-marking devices, combined with an auxiliary circuit, a signal receiving instrument operated by it, a number of circuit-closing switches, for the auxiliary circuit, independent operating devices therefor operated by the paper-moving train which require for their operation a long interval of time to be operated by the impulse of long duration only, restoring devices for the switches, and a number of circuit operating devices for the auxiliary circuit corresponding to and operated by the main signaling circuit.

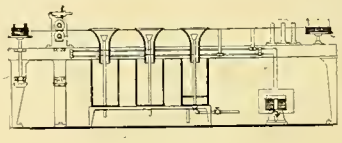
578,122. Combined Telephone and Annunciator System. James R. Strong, New York, N. Y. Application filed July 31, 1896.

A switch is described, having a series of yielding contact arms and a corresponding series of stationary contacts with circuit connections running to independent calling circuits, and an annunciator provided with an independent drop for each pair of such contacts, in combination with controlling mechanism having movement over the yielding contacts and provided with an indicator adapted to indicate the number of the circuit to be controlled or affected.

578,126. Telegraphy. Roderick H. Weiny, Arlington, N. J. Application filed September 4, 1896.

An automatic transmitter is provided with a conducting transmitting arm and a straight, stiff spring adapted to make mechanical contact with the embossments of a transmitting fillet, in combination with an arm adapted to act as a guide for the transmitting fillet, the arm being provided with a downward or angular inclination at one side of the conducting transmitting arm, whereby the embossments after carrying the movable arm to the extreme limit of its stroke are released as the fillet is drawn forward.

578,139. Electric Switch. William W. Doty, New York, and James A. MacKnight, Mount Vernon, N. Y. Application filed July 1, 1896.



NO. 578,170.

There are a pair of solenoids, bell-crank levers operated thereby and adapted to shift the switch-point, an automatic switch for controlling the current passing to the respective solenoid, and means for sending a current to the switch.

578,170. Annealing Apparatus. Charles P. Turner, New York, N. Y. Application filed February 8, 1896.

This apparatus comprises a wire-feeding device, contact-plates over which the wire is fed, the contact-plates being connected with an electric current generator, and means for subjecting the wire successively to the action of water, dilute acid and water after passing over the contact-plates, whereby the wire is cooled and scaled, pickled and the acid washed from the surface thereof.

578,171. Electrolytical Apparatus. Charles P. Turner, New York, N. Y. Application filed February 8, 1896.

An electrolytical apparatus is provided with an anode, consisting of a non-conducting receptacle coated with an anti-corrosive substance and provided with an outer coating of a conducting material, and means for connecting the outer coating with the positive pole of a source of electrical supply.

578,182. Apparatus for Regulating and Modifying Electric Circuits. Gustav F. C. Adam, Hanover, Germany. Application filed July 7, 1896.

In a switch for electric motor cars the combination is claimed with the switch-drums of the dog on the drum, the pawl fixed on the dog, the neck on the drum provided with recesses, the fixed support, the spring pawl on the same, the cord and spring.

578,233. Electric Arc Lamp. Anton Guendel, New York, N. Y. Application filed July 7, 1896.

There is one claim, which is here appended: In an electric arc lamp, a rotating shaft on a base-plate, two simultaneously rotating gear wheels or friction rollers with different diameters having their outer peripheries beveled and being attached to the said shaft, and two ratchet or friction bars guided in casings attached to the base-plate, and having their contact edges beveled to correspond with the bevels of the gear-wheels or friction rollers, one of the bars being engaged by one gear-wheel or friction roller, and the other one by the second gear-wheel or friction roller, in combination with carbon-holding brackets attached to the said ratchet bars.

578,266. Oil, Gas, or Like Engine. Walter Rowbotham, Birmingham, England. Application filed April 30, 1896.

Electrodes are arranged to pass a silent electric discharge through the explosive mixture in the cylinder or chamber.

578,275. Electric Circuit. John S. Stone, Boston, Mass. Application filed September 10, 1896.

An electric conductor consisting of a conducting core provided with a longitudinally discontinuous paramagnetic sheath conductively separated from the conducting core.

578,280. Dynamo-electric Machine and Electric Motor. Charles P. Turner, New York, N. Y. Application filed November 25, 1895.

A field magnet for dynamos and electric motors is formed of commercial wrought or cast-iron, with a facing of pure iron on the surfaces which adjoin the armature.

578,298. Train Controlling Device. Christopher A. Shea, Milton, Mass. Application filed October 14, 1896.

The combination is described of a closed train circuit, consisting of a battery, a resistance, an electro-magnetic mechanism operated by an increase or a decrease of current, a track circuit consisting of the rails of the track, a resistance connected thereto, and a contact rail connected to one of the track rails, and a contact arm carried by the train and adapted to cut in the track circuit through the train circuit.

578,304. Electric Rail Bond. Budd J. Jones, Chicago, Ill. Application filed April 29, 1896.

This device is a loop-shaped body portion formed of a series of strands or bars arranged side by side, so as to have lateral compactness, and rivet studs secured by casting or otherwise to the ends of such body portion, and arranged to project laterally therefrom.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MARCH 20, 1897. No. 12

Electrolytic Equipment at the University of Wisconsin.

In a recent article from the pen of W. B. Rankine a list of the contracts for power made by the Niagara Falls Power company up to November, 1896, appeared. From the figures there given the interesting and somewhat surprising fact is shown that of the 25,625 horse power contracted for, 12,425 horse power, or nearly one-half, is to be used in chemical industries, and, after subtracting 7,200 hydraulic horse power to be delivered to Niagara Falls Paper company, from the 25,625 horse power total, we have 18,425 electrical horse power contracted for, two-thirds of which is to be used in bringing about chemical changes.

If this in any way indicates the manner of utilizing the at present undeveloped water powers of this country it is also an indication of the large field of industry which will thereby be opened up—that of allied electrical and chemical engineering. It shows that while mechanical and electrical engineering go hand in hand, chemical engineering also joins hands with them in utilizing energy for industrial purposes.

It is an unfortunate fact that electrical engineers have devoted little time and attention to chemical questions, and that chemists have been equally negligent of the technical side of electrical engineering, and as a result the former have been telling of the disinfecting properties of electrolyzed salt water and the latter persist in describing an electric current as having a pressure of so many Smee cells and a quantity of so many volumes of gas liberated per second.

The University of Wisconsin has taken what seems to be the initiative among the engineering schools of this country in meeting this demand for electro-chemical and electro-metallurgical training. With this aim in view the usual electrical engineering subjects are supplemented by the following courses:

Primary and secondary batteries and their construction, operation and commercial use; electrolysis and electro-metallurgy, with their application to treatment of ores, separation and refining and electroplating of metals.

In the Department of Physical Chemistry, lectures and special instruction are given on chemical energy, thermal chemistry, electro-chemistry, with special attention to the theory of electrolytic dissociation, conductivity of electrolytes, electrolysis, primary and secondary batteries. In addition, the regular and advanced courses in inorganic and organic chemistry and well equipped chemical and assay laboratories are open to students.

The electrolytic laboratory occupies a large room on the second floor of the machinery building and an additional room for the grinding and polishing machinery. The electrical energy is obtained from the dynamo room, in which there are about 15 generators of different types and outputs. (See Western Electrician of August 22, 1896.) The 24 circuit switchboard shown at the right in Fig. 1 is connected by several sets of wires to a 200 terminal board of similar construction in the dynamo room. From this board the current may readily be conducted to the different parts of the laboratory as desired. A five horse power 110 volt motor-generator which transforms down to six volts for the electrolysis vats, eight 38-gallon enameled iron vats with rheostats, two lead-lined tanks for running water, two steam-heated iron tanks for hot water and lye, with chemical supplies, comprise the equipment for the electro-deposition of metals (Fig. 2). Two polishing lathes (Fig. 3), run by a 110-volt motor, and the necessary wheels and buffs furnish the means for grinding, polishing and burnishing.

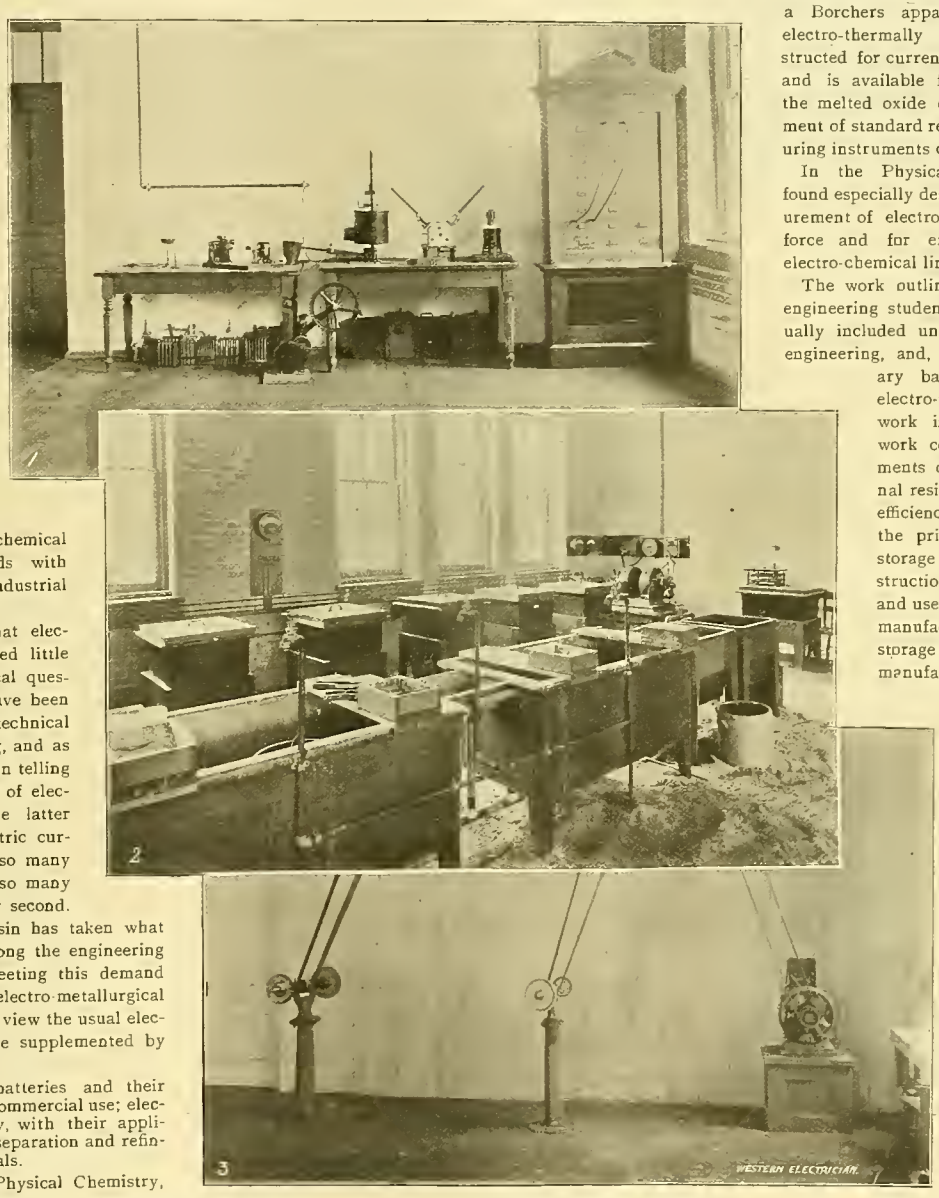


Fig. 1. Electric Furnaces and Switchboard. Fig. 2. Electroplating Room. Fig. 3. Grinding and Polishing Lathes.

ELECTROLYTIC EQUIPMENT AT THE UNIVERSITY OF WISCONSIN.

Fig. 1 shows switchboard and electric furnaces. The latter, three in number, are available for investigation involving the use of the high heat of the electric arc and the electrolysis of compounds fused by the heat of the electric current or by heat externally applied. The one in the middle is a Moissan furnace and large magnet for directing the arc which is maintained by a current of 100 amperes at from 40 to 60 volts. The electrodes are kept from excessive heating by circulating water. At the left a Borchers apparatus for the electrolysis of melted substances is shown. A carbon rod encased in a porcelain cylinder serves as anode, while the iron crucible serves as cathode. The heat for melting the substance is applied by means of a Perrot furnace and Fletcher burner. The apparatus is designed for a current of about 50 amperes and intended for the separation of such metals as magnesium, lithium, etc., from the double chlorides. The other, a Borchers apparatus for the electrolysis of electro-thermally melted substances, is constructed for currents of from 100 to 150 amperes, and is available for use in the separation of the melted oxide of aluminum. A full assortment of standard resistances and electrical measuring instruments completes the equipment.

In the Physical Chemistry Laboratory is found especially designed apparatus for the measurement of electrolyte resistances, electromotive force and for experimental investigation in electro-chemical lines.

The work outlined for the regular electrical engineering student consists in the studies usually included under the head of electrical engineering, and, besides, primary and secondary batteries and electrolysis and electro-metallurgy. The laboratory work in connection with the class work consists in making measurements of electromotive force, internal resistance and polarization, and efficiency and comparative tests of the principal forms of primary and storage cells on the market. Instruction is given in the setting up and use of primary batteries, in the manufacture, forming and care of storage battery plates, and in the manufacture of cells to be used for standards of electromotive force. A practical knowledge of electro-plating with such metals as copper, nickel, brass and silver may be obtained, also of the purification and separation of metals.

In addition to such required work, elective studies may be taken in physical chemistry, the theory of electro-chemical action and in special investigation. Among such investigations that have been carried on are the electrolytic action of the leakage currents of railway and lighting circuits upon iron and lead pipes, the electrolytic separation of lead and silver from carbonated ores, and the cost of decomposition of soluble chlorides by the electric current. Taken altogether, these features of the electrical work at the University of Wisconsin may be expected to yield still more valuable results in the important field of electro-chemistry.

O, the Drollery of the English Wits!

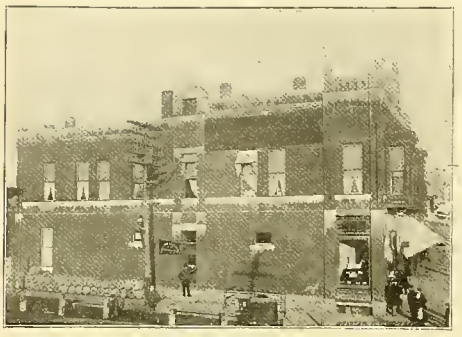
(From *Electricity*, London.)

A Blackburn electrician, Mr. Thomas Barton, who has just erected a telegraph line at Larne, writes complaining of the youths of the north of Ireland practicing marksmanship on his porcelain insulators, no fewer than 50 of which have been smashed in the course of a few weeks. These, I suppose, may be looked upon as his poor-slain insulators.

The Munsell Family Telephone Exchange at Hiawatha, Kan.

In the small telephone exchange at Hiawatha, Kan., herewith illustrated, C. H. Munsell is proprietor and manager, Misses Lulu and Pearl Munsell are the operators and Master Frank E. Munsell bears the title of lineman. The enterprise is thus a purely family affair; there are no stockholders, and every member of the operating staff is shown in the picture representing one of the rooms of the family residence, in which the exchange is located. The other picture shows the building in which the Munsell family lives and which houses the telephone exchange in consequence.

The division of labor by which the members of one



THE MUNSELL FAMILY TELEPHONE EXCHANGE AT HIAWATHA, KANSAS.—LOCATION OF THE EXCHANGE.

family easily carry on the business of a small exchange illustrates one of the possibilities of the independent telephone business. All the expenditure chargeable to salary account, as well as the profit, is kept in the family, and this, in a town of 4,000 inhabitants, like Hiawatha, amounts to quite a comforable income.

This little exchange also illustrates the fact that the independent telephone business requires no especial training; any intelligent man having business experience and good judgment may well make a success of it if he can secure a favorable opening and the confidence of those to whom he must look for patronage. Up to the age of 40 Mr. Munsell was engaged in the harness business and had had no experience in telephone work; but he has, nevertheless, with but a small cash capital, built up a successful telephone business in a year and a half. He secured a franchise in Hiawatha, and began operations in September, 1895, with 50 customers promised. The exchange was opened January 1, 1896, with 83 subscribers on the list. The service was satisfactory, and additional switchboard capacity was soon needed. There are now 125 subscribers connected with the exchange, and new ones are being added every month. Mr. Mun

THE MUNSELL FAMILY TELEPHONE EXCHANGE AT HIAWATHA, KANSAS.—OFFICE, SWITCHBOARD AND OPERATING FORCE.

sell is well liked by the people of the town, who take pride in the exchange located among them.

It is said that the plant and business established by Mr. Munsell's energy and enterprise are now worth over $6,000. It should be stated, also, that the entire equipment—instruments, switchboards, poles, wires and all—was supplied by the D. A. Kusel Telephone Manufacturing company of St. Louis.

New Telephone Publication.

The growing importance of the telephone industry is made evident by the publication of a monthly paper devoted exclusively to the interest of that branch of the art. The *Telephone* of Chicago, which has just made its appearance, is a creditable publication, and, judging from he first number, promises to be an important factor in the telephone field. Like the WESTERN ELECTRICIAN, the *Telephone* is on the right side of the controversy in which the Bell interests and the independent companies are engaged. The new journal will be conducted by men who are well known in the telephone field. James E. Keelyn, president of the Western Telephone Construction company, and Kempster B. Miller, chief of the engineering department of the same company, are the publishers of the journal. William R. Mackrille is the editor.

Hand-pressure Electric Drill in Shipbuilding.

The advantages of using electric drills in building modern steel ships are generally recognized. A recent instance of the use of electrically operated hand-drills for this work is mentioned by the *Electrical Review* of London, from which the accompanying illustration is reproduced. The *Review* says:

When Messrs. Yarrow & Co. were building the Argentine torpedo-boat destroyers Santa Fé, Entre Rios and others, they made use of Siemens Bros.' interesting hand-drill. The great feature about this drill is that it can be readily carried about by a workman, and may be used in any other position than that shown in the illustration by means of suitable slings. The drill spindle is driven through reducing gear by an electric motor, the current to which is supplied through a flexible cable, so that the drill may be at a considerable distance from the source of power. The whole drill is self-contained,

HAND-PRESSURE ELECTRIC DRILL IN SHIPBUILDING.

and is fitted with a cut-out and switch. To avoid any injurious shock on the termination of drilling, the end of the drill is fitted with an india-rubber cushion.

The drill illustrated will bore holes up to ⅜ inch in diameter, and weighs 46 pounds; the drill spindle runs at about 300 revolutions per minute; the motor takes a current of two amperes at a pressure of 110 volts, equal to a third of a horse power.

From experience it has been found that while eight holes per hour can be drilled by hand, 35 holes can be drilled in the same time with the electrically driven drill.

Anti-Bell Telephone Agitation in Massachusetts.

Reference has heretofore been made in this journal to the several bills before the Massachusetts Legislature to secure relief from telephone monopoly. The bills are in charge of Representative P. J. Kennedy, and he is making a vigorous fight. This is what he said at a recent meeting of the committee having the matter in charge:

Not only has the New England company no competition, but it is subject to no restriction as regards the character of its service. It is not so with the railroad corporations of the state. The state very properly sees to it that the interests of the traveling public are well protected; we have a board of railroad commissioners whose duty it is to regulate railroad fares, and also to see that suitable accommodations are provided; so we have a board of gas and electric light commissioners to regulate the charges and the service of gas companies. Why should not the state exercise a control over the telephone business?

The Bell Telephone company is a huge octopus. It has fattened on the exorbitant taxes that it has levied on a helpless community until it is to-day more oppressive on the community than any trust in the nation. It was organized in 1880 with a capital stock of $7,350,000, and it has not only paid enormous dividends on the original capital invested, but it has watered its stock so that a year or two ago it applied to the Legislature for an increase of $50,000,000. The actual earnings of the company can in no degree be gauged by the dividends declared. The earnings are paid over in royalties to the Bell company, and if the royalties levied on the branch company for the use of patents is not sufficient to eat up the earnings a new patent is declared necessary for the betterment of the service, of course.

In the town of Stoughton, only a few miles away from Boston, the business men of the community, exasperated over the exorbitant charges of the New England, and the poor service they were getting, organized a telephone company of their own about six months ago. This company has about 100 subscribers to-day. It does not use

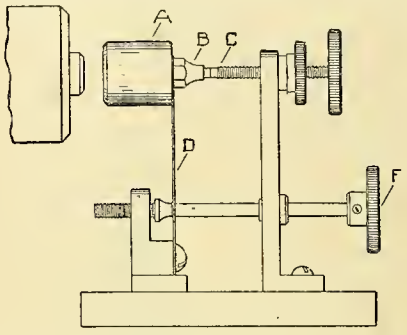


FIG. 1. AN IMPROVED AUTOMATIC INTERRUPTER FOR INDUCTION COILS.

the patents of the Bell company, but nevertheless furnishes an excellent service at the rate of $1.50 per month for offices and $1 for residences. The New England company charges $6 per month in the same town for service that is no better. The people of Stoughton should be protected and the people in every city and town in the state as well by authorizing bona fide competing companies to connect with the wires of the New England company, so that subscribers of the one may hold conversation with subscribers of the other.

An Improved Automatic Interrupter for Induction Coils.[1]

BY H. LYMAN SAYEN AND ELMER G. WILLYOUNG.

For a number of months we have been engaged in the systematic development of induction coils, with particular reference to their use in practical X-ray work. The requirements which must be met in such apparatus are vastly more severe than those which have belonged to induction coils as heretofore made. Up to the time of Prof. Röntgen's discovery coils have been used only for occasional demonstration in academic class-rooms and occasionally for certain scientific investigations, as, for example, in spectroscopic analysis. Under these conditions a great many inconveniences could be put up with without difficulty. The strains put upon the coils lasted but for a short time, and occasional sticking of

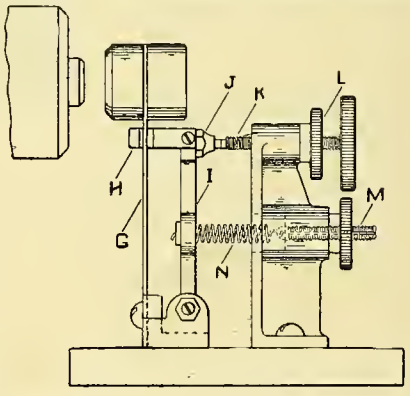


FIG. 2. AN IMPROVED AUTOMATIC INTERRUPTER FOR INDUCTION COILS.

the vibrator or excessive burning of the contact points during the brief period of the coil's action were permissible. Now, when coils must be run for an hour or two continuously, and, further, must be run by a class of users whose training in physics and the use of physical apparatus is exceedingly meagre, it is obvious that all these small details must be greatly perfected. A number of the improvements which we have made we have presented to you in previous papers. We wish to-night to bring before you a new form of automatic interrupter which possesses, in our opinion, many advantages over other forms of interrupters, and which in some respects, we believe, is unique.

In Fig. 1 we illustrate in diagram the well-known Apps vibrator, which is, perhaps, as largely used all over the world as any form of vibrator thus far devised, and which in its construction and operation is typical of the majority of known forms of vibrators. In action,

1. Read before the electrical section of the Franklin Institute, Philadelphia, January 26, 1897.

the hammer-head is attracted by the iron core, thus breaking the contacts *B* and *C*. The head *A* immediately flies back by virtue of the resiliency of the spring *D*, thus again closing the contacts *B* and *C* and allowing the process to be repeated. The tension of the spring may be varied by means of the lower adjusting screw *F*, which, however, it will be observed, applies the force in a manner mechanically undesirable. But the chief defect in this type of vibrator is the defective principle involved. We see that the circuit is closed by the coming together of the points *B* and *C*. In breaking the circuit, we require, theoretically, great suddenness, but this we are obviously unable to get since the hammer-head is at rest and requires a very appreciable time to attain any great velocity of movement, while the current is reduced nearly to its zero value by the first infinitesimal movement of the contact point, thus correspondingly reducing the magnetic pull. Furthermore, the violent blow given to the one contact point by the other throws the spring into a condition of forced vibration, which entails consequent irregular breaking and corresponding irregular discharge in the secondary.

Turning now to Fig. 2, we see that the plan of interrupter is entirely different from that just described. The spring *G* is supported at its lower extremity, just as with the Apps vibrator, but is otherwise entirely free. Surrounding the spring, near the hammer-head, is a yoke *H*, rigidly attached to a stiff casting *I*, which is itself pivoted below. This casting carries the front contact point J. The back contact point *K* is controlled by a pair of setscrews *L*, while a lower adjusting screw *M* controls the tension of a helical spring *N*, itself attached to the casting *I*. The spring *G* is very stiff and when vertical stands entirely free of the yoke *N*. In action the hammer-head is attracted by the core, but, quite otherwise than in the Apps interrupter, is able to move a considerable distance and attain a very high velocity of motion before striking the yoke, and thus breaking the circuit. The magnetic pull on the hammer-head being thus released, the hammer-head flies back, partly by virtue of its own spring *G* and partly on account of the pull of the spring *N*. The contact points coming together close the circuit once more, and the core's magnetism immediately begins again to act upon the hammer-head, the motion of which, however, it cannot instantly stop, and the head swings on, being gradually brought to rest and its motion reversed again, striking the yoke while moving at high speed.

That the suddenness of this break is vastly greater than with the Apps break is evidenced by several facts. In the first place, the arcing is practically nil, and when coils—say 8 to 12 inches even—are run with it upon a proper electromotive force, it is actually necessary often to look closely at the vibrator in order to see any sparking whatever. Further, after continuous runs for 30 or 45 minutes, or even more, there is no appreciable rise of temperature even at the contact points, while with the Apps break the entire mass of the vibrator would have become too hot for the touch. A further evidence (and this is of decided importance) is that the same coil operated by the new vibrator, as compared with the Apps, requires not over one half the current to produce results equally as good, if not better.[1]

Another feature of this new vibrator, gained for it by the characteristics which we have just brought out, is that it is capable of direct use upon a commercial circuit of 110 volts, requiring only a rheostat in series with primary to hold the current down to a suitable value. The sparking on such a circuit is greater than with battery, though not so great as with the majority of the vibrators now used with various coils when run by battery.

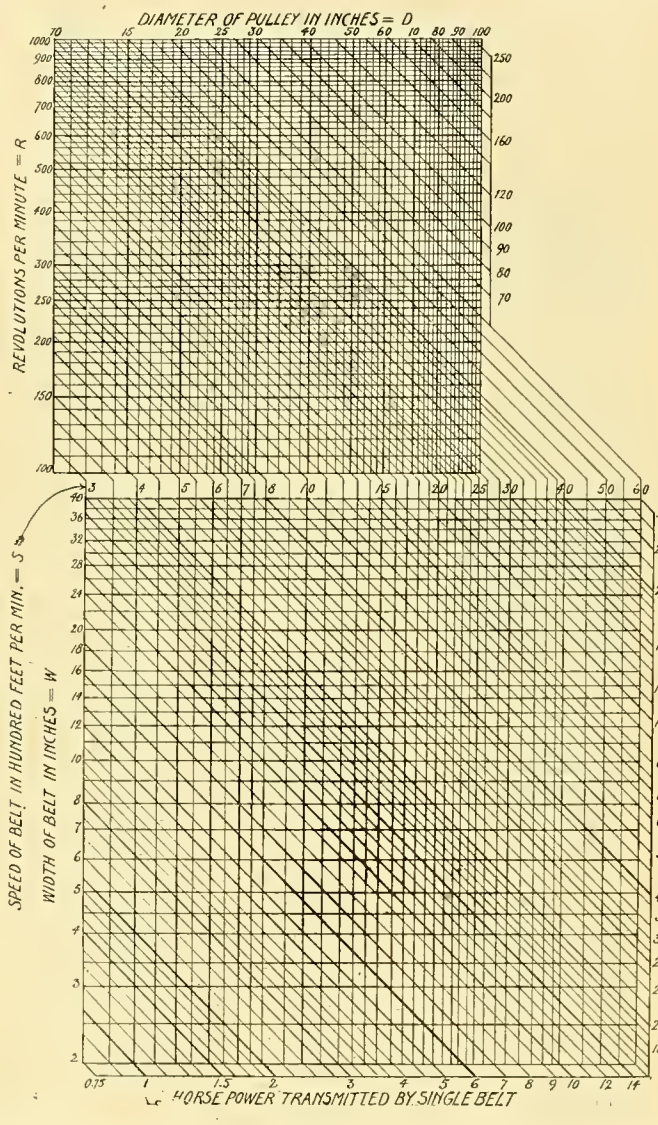
It is clear that with this form of vibrator we also get rather longer makes than with the Apps vibrator. To change the speed of the vibrator we have only to screw a vertical rod into the hammer-head and upon it place an adjustable bob.

Workers with induction coils have probably noticed the irregular secondary discharge often produced where the vibrator castings were weak or insecurely fastened to the base. This is due to the parts getting in to a condition of forced and independent vibration, partly due to the shocks sustained by the contact points, and partly to the vibrations produced in the coil and reinforced by the resonance of its base. In our vibrator we have successfully overcome this difficulty by making our castings very stiff and mounting the parts upon a hard rubber base, which base we carefully surround by heavy felt, and then by a brass box, which clamps the whole firmly to the base. In this way the vibrator is not mechanically connected to the rest of the apparatus, and any vibrations transmitted to it are instantly damped out by the felt.

Horse Power Transmitted by a Single Belt.

S. T. Freeland, writing to the *American Machinist*, gives the accompanying diagram for ascertaining the speed of, or the horse power transmitted by, a single belt. The table is so arranged that, having the other factors known, any one unknown factor may be readily determined. Referring to the diagram, it will be noted that the distance between the figures is divided into spaces, each representing a certain division between the two numbers, in some cases meaning ½, in others 1, and in others 100. A few moments' practice will easily familiarize the reader with the plan.

Suppose, for instance, we have a 40-inch pulley to run 200 revolutions per minute, and wish to take from this pulley 10 horse power. What we wish to know is, How wide must the belt be? At the extreme top of the diagram is a row of figures standing for pulley diameters, and taking 40 (the diameter of our pulley in this case) we follow the vertical line designated 40, down to its intersection with the horizontal line which is designated at the left 200 (which number represents our number of revolutions per minute), and from this point of intersection we follow the line diagonally downward and to the right until we come to the line of figures representing belt speed in hundred of feet per minute, and we find it is nearly 2,100 feet. This last figure is not needed in this instance, but the diagram shows what it is, and it costs us nothing to note the speed. From this point we follow vertically downward until we intersect the diagonal line representing 10 horse power (numbered at the bottom of the diagram), and the figure at the left of this point of intersection shows that the belt must be four inches wide.



Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Plainview Telephone company of Plainview, Minn., has been incorporated, with $5,000 capital stock, to connect with the other towns in Wabasha county.

The Western Electric Telephone company has been granted a franchise at Lake Mills, Ia., for a telephone exchange.

The Northwestern Telephone Exchange company is securing a right of way through Winnebago City, Minn., for its long-distance line.

The American Telephone & Telegraph company has been granted a franchise at Iowa City, Ia., and Marengo, Ia.

There is a strong movement on foot at Fennimore, Wis., for a farmers' telephone line from Lancaster to Fennimore. H. H. Hampton is an active supporter of the enterprise.

The Wood County Telephone company of Grand Rapids, Wis., is making a canvass to ascertain how many more instruments would be used if the residence rate were reduced to $1 per month. If 25 new subscribers can be secured in Centralia and Grand Rapids it will be done.

E. B. Smith of Omaha, general superintendent of the Black Hills Telegraph & Telephone company, says that the company will make extensive improvements on its system in the Black Hills, including a metallic circuit to Balmoral, Terry and Portland, from Deadwood, S. D., and rebuilding the line from Rapid City to Custer. The line from Spearfish to Sundance, Wyo., will be taken down and abolished, as it does not pay expenses.

The Wisconsin Telephone company has reduced its long-distance toll rates for night messages one-half within the state.

A vigorous fight is anticipated when the West Superior, Wis., council takes up the application of the new Citizens' Telephone company for a franchise. The matter will be considered April 6th.

The reports given at the meeting of the Iowa Telephone association in Des Moines, consisting of all independent telephone companies in the state, show the use of such instruments has increased 40 per cent. in the last year and the mileage of these companies has increased 50 per cent. The lines reach all points of importance in Iowa except a few county seats in the extreme southeast and northwestern portions of the state. The toll lines reach 264 towns and cities in the state.

The council of Des Moines, Ia. has decided to refuse a renewal of the franchise to the Iowa Telephone company until that company reduces its rates and recognizes the right of the city to regulate them.

The Northwestern Telephone Exchange company has completed and opened its long-distance line west to Fargo, N. D., and now has connection from La Crosse, Wis., to Fargo and also to Sioux Falls, S. D. Sioux Falls connects with Fargo via Minneapolis, a circuit of about 500 miles. The lines have been tested and worked perfectly. Customers along the line were treated to a concert by the Fargo Mandolin club, performing in Fargo.

The present patrons of the Northwestern Telephone Exchange at Red Wing, Minn., who are supplied with automatic instruments, are complaining because the company proposes to supply all new subscribers with instruments for a central exchange connection, and leave the old subscribers with the automatic instruments. They think it would result in confusion, delay and vexation generally.

The committee sent from Burlington, Ia., to Keokuk, Ia., to examine the plant of J. C. Hubinger there, reports the exchange to be superior to the Bell exchange in operation in Burlington, and earnestly recommends the establishment of a similar exchange in Burlington. Mr. Hubinger is an applicant for a franchise at Burlington.

The Mississippi Valley Telephone company of Keokuk, Ia., is an applicant for a telephone franchise at Council Bluffs, Ia., and Omaha, Neb.

The Iowa Telephone company will soon have long-distance connection between Burlington, Ia., and Boston, New York and other eastern cities.

The Northwestern Telephone Exchange company is sounding sentiment along the line of the Great Northern railroad as to a long-distance telephone between Sioux City, Ia., and Minneapolis, via Willmar.

A telephone line to connect Black River Falls, Wis., with Blair, via Taylor, Hixton, Alma Center and Merrillan is projected.

1. In actual test of a 12-inch coil, while giving 10-inch sparks, a 2-inch piece of No 32 copper (B. & S.) wire was inserted into the primary circuit and grasped between the thumb and forefinger. The heating was not too great to be easily endurable.

Regulation of Arc Lamps.

It has been contended that the arc lamp has not advanced in keeping with the development in other branches of the art, the principal points of criticism being appearance and regulation. At the present time much thought is given these points, the latter particularly, and it may not be amiss here to call attention to the work that is being done abroad, although American engineers do not generally admit that there is anything to learn from foreign practice in arc lighting. Three distinct types of arc lamps are herewith presented. They have been in use long enough to confirm the good opinion of those who favored their introduction and they are generally regarded as the best examples in their respective classes that are now used in Europe.

The first of these is the Eck arc lamp, Fig. 1, which belongs to the differential class and has no mechanical regulation, the separation of the carbons being controlled solely by magnetic action. The diagram, Fig. 2, shows that the lamp comprises two solenoids, one of which, S, is wound with coarse wire in the principal circuit, while S' is made with finer wire, and is in shunt around the lamp terminals.

Two cylindrical cores of soft iron, N and N', play within these two coils. They are connected through the

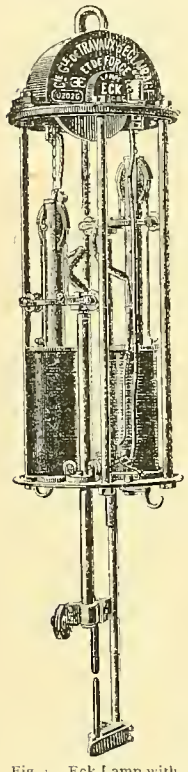


Fig. 1. Eck Lamp with Cover Removed.

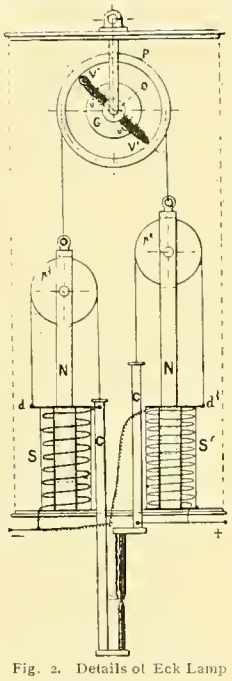


Fig. 2. Details of Eck Lamp

REGULATION OF ARC LAMPS.

medium of a chain over the fixed pulley P. Each carries a small pulley, P' and P^2, over which a cord plays, one extremity of either being fastened at d and at d', the other extremity being attached to the carbon carriers C and C'. The movement of one acts reversely on the other. The bobbin of S, in series with the arc, has its ampere-turns determined by the intensity of the arc, while that of S' is determined by the resistance of the arc. For a 10 ampere lamp at 40 volts the bobbin of fine wire will have 6,417 turns and a resistance of 118 ohms. The current flowing through it will be .333 ampere, and the ampere-turns will be 2,140. The coarse wire bobbin will have under the same conditions, 214 turns, and the ampere-turns will be 2,140.

But the attractive power of the solenoids varies with the depth to which the cores enter the coils; and this interferes with the normal function of the lamp. In fact, while the carbons are new and of full length the coarse wire core will be seen totally immersed in its coil, and the core of S' will be almost withdrawn. This naturally tends to lengthen the arc. It is true that this widening of the arc increases the resistance and consequently makes the fine wire solenoid more active, but this is not sufficiently sensitive or positive, and a simpler method of regulation has been devised.

The pulley P, Fig. 3, is not centered on the axis O, but is held by the pressure of two screws v, v', against the plate G, which is centered on O. The arbor of G is threaded and holds the adjusting screw V, V'', the extremities of which, as shown, abut against the inner periphery of the plate. Movement of this screw carries the pulley away from the center O.

When the lamp is freshly trimmed the screw V, V'' takes the position shown in Fig. 2; when the carbons are half consumed it becomes vertical, as shown in Fig. 3, and when these are entirely consumed it takes the position shown in Fig. 4.

If then the pulley is lowered below the axis O, when lighting the lamp, as in Fig. 2, the arm of the lever on the right will be longer than that on the left, and consequently the effort made by the fine coil will be assisted by

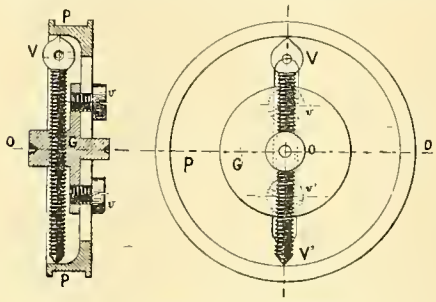


Fig. 3. Side and Front Elevation of Regulating Pulley in Eck Lamp.

REGULATION OF ARC LAMPS.

the longer arm of the lever, in its efforts against the deep inserted core of the coarser coil.

This advantage is gradually lessened as the carbons wear away, and the pulley changes position in consequence, the gradual loss of leverage on the one side and the resultant gain on the other perfectly compensating for the consumption of the carbons, making the lamp a thoroughly adjusted one.

The current enters at the + terminal, passes by a flexible cord to the upper carbon holder, through the carbon, across the arc, the lower carbon, through the coarse coil, which draws in its core, opening the arc thence to the — terminal. A shunt wire around the arc feeds the fine wire coil. At the instant of lighting, if the carbons are not in contact, the fine wire alone is carrying current. The core is drawn in, the carbon holder lowered and contact is formed; the coarse coil now acts, the carbons are drawn apart, the arc is established and equilibrium remains fixed. As the carbons are consumed the resistance of the arc increases, the intensity decreases, the coarse wire coil is less vigorous, and at the same time the electromotive force is augmented, because the rheostat in the circuit, being fed by

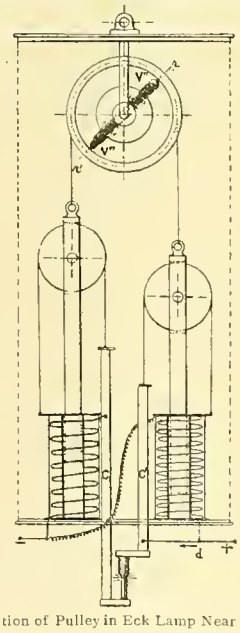


Fig. 4. Position of Pulley in Eck Lamp Near End of Run.

REGULATION OF ARC LAMPS.

a current of less intensity, requires smaller voltage, and the fine wire solenoid gains an advantage. This see-saw or alternate action is so sensitive as to be practically imperceptible and constant. The regulation of the lamp, then, depends upon

First—The number of turns of the bobbins, decided beforehand by calculation.

Second—The eccentricity of the pulley P on the axis O, which, once settled, remains permanent.

Third—The amount of plunge of the solenoid cores, and the weight of these.

The Eck lamp may be grouped in pairs in series on 105 or 110 volts, and any number in direct constant current arc circuits, requiring 45 to 50 volts per lamp.

In the Klosterman lamp, "la moderne," which is the second type, there is no clockwork; the movements of the apparatus are all electro-magnetic. For the flexible cord, usually of silk, which connects the carbons in catch systems, there is here substituted a metallic chain. The regulation is effected by means of an electro-magnet, of which the movable core is near an iron fly-wheel and carries a brake at its upper extremity attached in such a manner that when the core is magnetized it is released and acts on the wheel, which is made to follow the movement of the core, making part of a revolution. In other words, a magnetic derivation through a brake with this wheel does the work.

The lighting is accomplished through an electro-magnet with a movable core, which, when the current passes, is drawn into the coil, and at the same time adheres to a small wheel of iron, which it draws to itself, producing a displacement sufficient to establish the arc.

Now, referring to the plan of the lamp as shown in Fig. 5, the principle and method will be better compre-

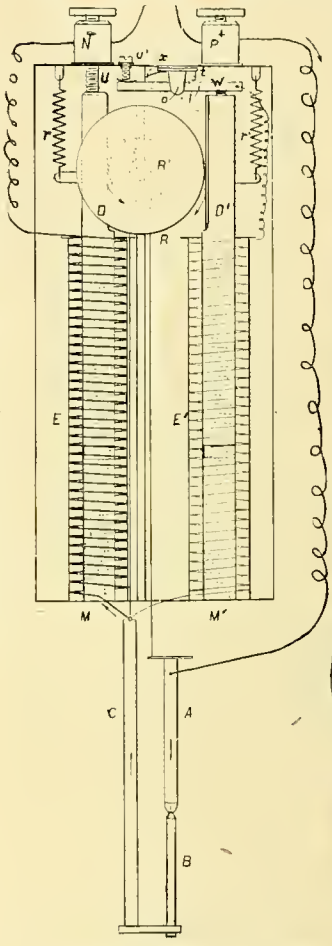


Fig. 5. Section of Regulator of the Klosterman Arc Lamp "La Moderne."

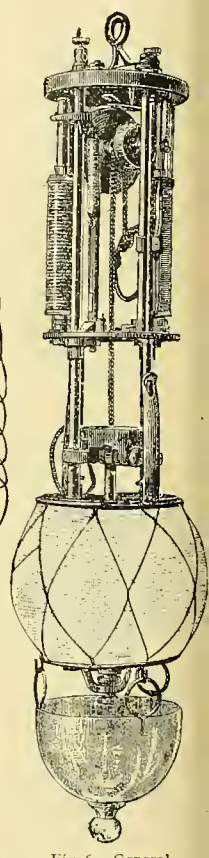


Fig. 6. General View.

REGULATION OF ARC LAMPS.

hended. As is not uncommon with arc lamps, the positive pole of the lamp is the mass of the apparatus, while the negative is insulated, and the current is carried to the upper carbon by a flexible conductor. When inoperative the carbons are in contact, and when the current is turned on it reaches the negative carbon, flowing thence to a solenoid E, the upper extreme of which is in contact with the binding-screw N'—the negative terminal. Within this solenoid E are two cores. One at the lower end is fixed M, and there is a movable core in the upper half of the coil D. A spring r tends to hold D against the adjustable screw U, which regulates the depth of the plunger D, and limits the separation of the carbons. Immediately the current flows through the coil E, the plunger D is strongly drawn downward, carrying with it the wheel R' by friction. On the axis of R' is a chain, the two extremities of which are attached to the two carbons, as shown, both of which are moved by the revolution of R', which results in a particularly steady action of the carbons and a correspondingly constant illumination. An electro-magnet E' has also a fixed and movable core, similar to the one just mentioned, D' and M'. This solenoid is placed in parallel between the negative carbon and the positive binding-post P, through the lever l and the frame, the

motion of this lever being limited by the set-screw a', which, as well as the fulcrum o, is insulated from the frame. A small spring x tends to steady the lever l. Connecting points are made with platinum. D' forms the closing point of this circuit at W; l is the upper limit stop of l. Now, the arc being established, the derived current passes through the solenoid E', and draws the plunger D', which attracts l and closes the circuit of the shunt. At the same time an iron shoe presses against and revolves the larger wheel R, which is on the same axis as that before mentioned, and which carries the regulating chain. At this point an equilibrium is established between the strain of the spring r' and the attraction of the plunger D'. When the arc has become too long the plunger is drawn downward, bringing l with it, until it breaks the contact with the lever current ceases in the shunt, and D resumes its function of a brake, holding the chain wheel from affecting the carbons, while D' and l assume their normal position of separation.

The regulation, according to *L'Eclairage Electrique*, from which the illustrations are taken, is so quick and so easy withal that only a steady, painstaking attention for a considerable time will reveal any fluctuation in the illumination.

None of the parts is of a character to deteriorate except under long continued service, while the movements are all positive and energetic, being due to the current itself, and hence uniformly the same.

A general view of the lamp is given in Fig. 6, which still further shows the internal parts of the lamp, the outer covering being removed for that purpose.

The lamps are made for both continuous and alternate currents. The smallest size of the former variety consumes from three to four amperes at 110 volts.

The regulation of the Barrière arc lamps, the third of the series, is accomplished through a ribbon brake and a peculiar arrangement of the bobbins which makes them singularly sensitive.

For ordinary intensities the lighting is produced automatically, regardless of the initial distance of the carbons; for feeble intensities this establishment of the arc requires hand adjustment.

These properties of the Barrière system have made possible an arc lamp of one ampere, which may supplant without special arrangement a center lamp of oil, gas or other illuminant, as shown in Fig. 7. Current may be brought to it precisely as for an ordinary incandescent lamp—by cord—and a turn of the button lights it in precisely the same manner. It burns with perfect steadiness, and when the carbons are exhausted it extinguishes itself quietly, and without danger.

The regulator, Fig. 8, comprises two solenoids, A in the circuit proper and A' in derivation. The upper portions of these contain fixed cores, which are pierced through the line of their axis, and the lower portions contain movable cores, the motions of these latter being limited by a stop v, Fig. 9. The two plungers c and c', Fig. 8, attached to the movable cores, move through the openings in the permanent cores, and are connected, one to a lever E, the other to a cross-head e, having a lateral branch with an interrupter at F. There is also fastened at this point a peculiar shaped spring, Fig. 10, which encircles the pulley C, its other extremity being fastened to the upper plate of the lamp. The carbon holders G and H (the former weighted with lead) are attached to the same cord, which goes over the pulley l, the axis of which is placed upon the lever E, between the spring and its proper axis, and the other end goes in like manner once around the drum m. On the bobbin A' is shown at s a piece in Z-shape which acts as an interrupter of the current at the contact point of the screw at F.

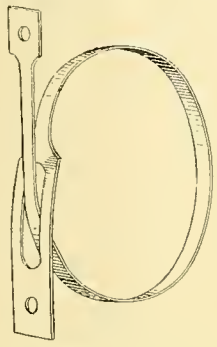


Fig. 10. Ribbon Brake for Barrière Arc Lamp.

REGULATION OF ARC LAMPS.

Now, if the current is sent through the lamp its course from the dynamo is through the coil A'; the movable core is drawn upward, the brake is released and the carbons approach each other. When an interruption of the current takes place at F the core is dropped, the carbons are arrested and the movement is repeated. Thus the interrupter has the effect of bringing the carbons together gradually, and without concussion. The carbons being in contact the entire current passes through A, the core b is drawn upward, and the pulley l descends; the carbons now assume the proper distance for the arc. As the consumption proceeds the current divides, a portion passing through A'. The movable core is gradually drawn upward, the brake is noislessly loosened and the carbons approach as before, the luminous point remaining absolutely stationary in the lamp.

With currents of feeble intensities the system of bobbins A and lever E are suppressed, the lighting being produced by hand through a button at the extreme of the brake pulley axle.

Fig. 11 shows the arrangement when the regulator is below the lamp, as in Fig. 7.

A number of tests have been made with this lamp, with pronounced satisfaction. On one occasion it was recorded that at 110 volts 11 amperes were required to put the lamp in operation, when after a period of seven minutes, required for adjustment, the lamp burned quietly for eight hours, consuming but eight amperes—880 watts. On another occasion the report said that the regulation was effected without shock or noise, and the illumination was remarkably steady. With a Richard registering instrument the difference of potential never varied over three volts. The cuts are from *L'Electricien*.

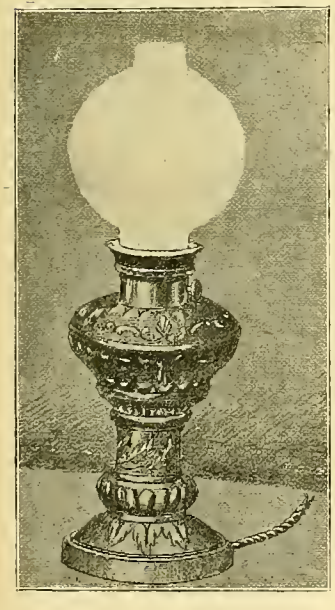


Fig. 7. Barrière Table Lamp.

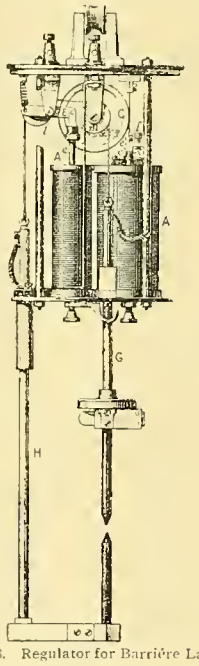


Fig. 8. Regulator for Barrière Lamp.

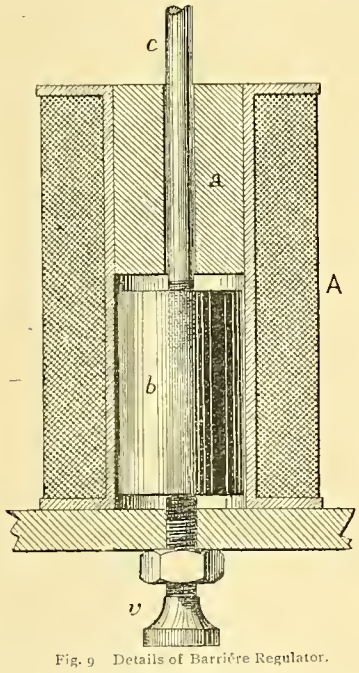


Fig. 9 Details of Barrière Regulator.

REGULATION OF ARC LAMPS.

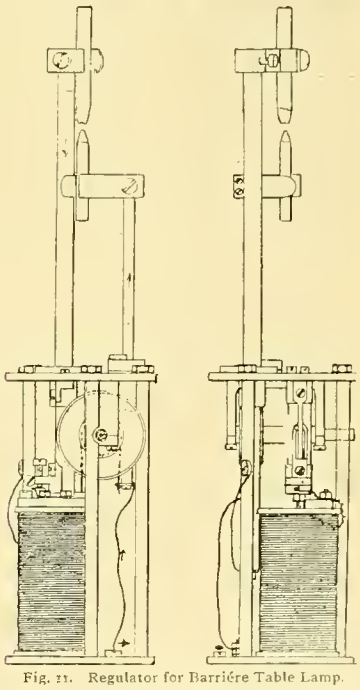


Fig. 11. Regulator for Barrière Table Lamp.

Texas Gas and Electric Light Association.

The third annual meeting of the Texas Gas and Electric Light association will be held in the Menger Hotel, San Antonio, Texas, on April 19, 20 and 21, 1897. Papers will be read as follows:

"The Commercial Efficiency of the Incandescent Electric Light"—H. L. Monroe, Dallas.

"A Means of Largely Increasing the Summer Sendout of a Gas Works"—J C. Lord, Fort Worth.

"The Storage Battery as an Adjunct to Small Electric Light Plants"—W. L. Hall, Mexia.

"A Few of the Many Details of Management"—A. E. Judge, Tyler, Texas.

"Little Things"—W. E. Holmes, Austin.

"Operating Expenses of Electric Light Plants"—J. D. Oliger, Cleburne.

"Electrolytic Deterioration of Water and Gas Mains"—W. A. Fraser, Dallas.

It is expected, and an effort is being made, to have an exhibit of gas and electrical appliances, which, it is believed, will be both interesting and instructive. The last day of the meeting is San Jacinto Day—a great holiday in Texas, and in San Antonio especially, when the Battle of Flowers takes place. Effort is being made to obtain cheap railroad rates, and everything will be done to make the expense of attending as light as possible. F. R. Starr, Jr., of Gonzales, Texas, is the secretary of the association.

Setback for the Trolley Conduit Project in Chicago.

A financial writer in the *Chicago Record* advances the opinion, in the issue of that paper for March 12th, that the system of trolley conduit railways on the South Side Chicago, proposed by the General Electric Railway company will never be built. He says:

City Railway was in good demand, and advanced rapidly from 218 at the opening to 225. The cause of this advance is the passing of the General Electric enterprise as a menace to the value of City Railway. The promoters of the scheme, which at one time promised sharp competition on the South Side, have been unable to secure funds to begin work; the attorney-general has taken a hostile attitude to the company, and the Humphrey bills now pending at Springfield, which it is believed in street railway circles will successfully pass the Legislature, will operate unfavorably on the General Electric. The measures were drafted in such a manner that the company is excluded from the valuable privileges given to the other systems in Chicago.

Lansing, Iowa, has voted for an electric light plant.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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THE man who purchased 100 shares of Keely motor stock at 4½ last week possesses a confiding nature that is truly edifying. But his friends should see to it that his identity is not revealed. There are already many anxious inquiries for his address.

SERIOUS charges against the Metropolitan Traction company and the Third Avenue Railroad company of New York are preferred by the *Herald*. Complaint is made that gross abuses are practiced by employes of these corporations, and it is alleged that the companies pay no attention to the matter when the misconduct of conductors and gripmen is reported. "Such annoyances are common," it says, "because the street railway employes know that they will not be punished if reported." This statement conflicts with the representations of General Manager Littell, of the Metropolitan company, who, in discussing the question of discipline at the last meeting of the American Street Railway association, said that every complaint against an employe of the company, no matter how trivial, was thoroughly investigated. In such a large corporation it is to be expected that causes for complaint and criticism will appear, but where the management shows a disposition to correct abuses it should receive encouragement and co-operation from the public, and the daily press should assist in the good work. Some of the metropolitan journals, however, seem inclined to create and encourage public prejudice against corporations, especially those engaged in public service.

LATE reports from Paris indicate that the storm which visited that city and vicinity early this month was one of the most violent of its kind on record. It was not in the nature of a cyclone, but the damage was widespread and disastrous. Telegraphic and telephonic communication between Paris and the rest of the world was seriously impeded, and, in many instances, the wires were completely broken down. Railway communications were considerably interfered with.

The violence of the storm at one time was so great that much alarm was felt, and business was practically suspended. Only one telegraph wire was working between Paris and London, and even that was behaving badly, while telephone communication was also broken. This condition had a depressing effect upon the Bourse, as shown by the remarkable falling off of the business. An official report of the observations made on the Eiffel tower will bep repared, and this, together with the records of the September cyclone, ought to furnish abundant material for speculative discussion by French scientists.

AT last the management of the Manhattan elevated railroad is confronted with the problem of instituting radical changes in the methods employed in that system or submitting to a constant decrease in earnings, which will make it necessary for the stockholders to accept smaller dividends, if indeed they are not called upon to submit to an assessment to meet a deficit. It is probable that this condition of affairs will lead to the immediate consideration of the substitution of electricity for propelling, lighting and heating the cars. The reduction of one-third in the quarterly dividend last week is not relished by the stockholders, and it is looked upon generally as a direct result of the policy of the company in failing to comply with the demands of its patrons. Public opinion is concisely expressed by one writer, who sums up the situation as follows: "Insufficient train service, dirty and ill-lighted cars and the general crowding and discomfort of travel on the elevated roads have driven away the public, and the resulting decrease in receipts has made it necessary to thus cut down the dividends on the stock of a corporation which enjoys the most valuable railway franchise in the world." The only hope for the company rests in the immediate transformation of the railroad into an electric system after the manner of the Chicago elevated electric roads.

VALUES in public franchises are said to be depreciating in Chicago because of the conditions under which grants are made from time to time by the City Council. Holders of these franchises are very anxious to protect their property and many schemes have been devised for safe-guarding them, but in every case the objection is raised that the corporations now in control of the field have not given the municipality directly any valuable consideration for the privileges which they enjoy, and, therefore, it is contended, they are not in position to demand the exclusion of others who wish to share the field with them. It is now admitted that it would have been better for existing companies to have paid the city at the outset for the valuable grants which they enjoy, as it would give them some claim in equity to an exclusive franchise, but the short-sighted policy of the promoters did not provide for this contingency. Year after year the Council grants additional franchises to companies about which nothing is known, although it is generally believed that they are composed principally of politicians who adopt this method of levying blackmail upon existing companies. It is true that some of these ordinances fall in the hands of men of sufficient capital to conduct independent companies in competition with the older corporations, and thus, occasionally, the people are directly benefitted, as in the case of the Ogden gas ordinance. That measure was vigorously opposed as a "boodle ordinance," yet the householders of a considerable section of the North Side have reason to be grateful to the men who secured competition in that district.

The street railway field has had considerable attraction for a certain class of promoters. Old companies have been threatened with competition, ordinances have been passed giving valuable rights to rival corporations that have absolutely no standing in the financial world, and while active competition has not come out of these measures the effect has been disastrous on the value of the securities of the old companies. Such grants have practically the same effect upon existing corporations as the clouding of the title to a piece of real estate. It raises a question in the public mind and causes uneasiness among investors. It is believed that the Humphrey bills now before the Legislature will have the effect of restoring public confidence and giving stability to securities of legitimate street railway enterprises. Unfortunately for the transportation companies the measures are opposed by many who feel that to place the street railway business of Chicago in the hands of the present corporations exclusively would be little short of a public calamity. They contend that no improvement could be expected in the service when the fear of competition would be removed. All those who are now or have been dissatisfied with the management of existing street railway companies find this an excellent opportunity to square accounts. If the Humphrey bills are defeated the street railway companies of Chicago can blame themselves alone.

VERY strong claims are made by the Board of Electric Light Commissioners of the city of South Norwalk, Conn., for the efficiency and economy of the municipal plant which has been operated by it during the last four years. The ordinance creating the board was passed on September 17, 1892, and one of the provisions gives the council authority to fix the compensation of the commissioners. Thus far, it appears, the gentlemen composing the board have contributed their service to the city. This is a condition of affairs that is peculiar to South Norwalk. In larger communities it would be hard to find men competent to conduct an enterprise of that character who would not demand compensation. Generally speaking, it has been found that boards of this character are the most expensive in the long run. Public officials who do not receive direct pecuniary return, as a rule, neglect the duties of the office or use their positions to advance their private interests. So far as we have learned there seems to be no tendency on the part of the taxpayers of South Norwalk to complain of the administration of this department of the public service, but it seems as if the Connecticut town was inviting disaster by establishing such a policy in its public service.

According to the report the street lamps were burned 317 nights during the year on an average of seven hours per night. The candle power furnished is given at 1,200, and the average cost per lamp per night is 18.6 cents. As usual in city plants, the figures published do not include all of the items which central station practice shows should be charged against such service. No insurance is carried, as the commissioners do not consider it necessary. Water rent and city taxes are not included in the expenses of the plant, although these items are comparatively small. Only five per cent. depreciation is charged, and this upon only a part of the plant.

It is but just to the commissioners to say that these facts appear in their report and that no effort is made to conceal them. It would be manifestly unjust, however, to compare the cost of this plant with that of other cities where local pride does not move prominent men who are capable of conducting such enterprises to contribute their services. If to the present cost of street lighting service, as computed by the commissioners, an addition is made covering the items already mentioned and making provisions for the employment of men to conduct the plant in place of the commissioners, the actual cost of the service would be materially increased, and this of course is the only fair basis upon which to make comparison. It appears that the gentlemen comprising the board are giving valuable service to their townsmen without compensation. While we may applaud their disinterestedness we question the wisdom of such a policy. We believe it would be far better to put the lighting business upon a strictly commercial basis.

Chicago Underwriters Ignore Barrett's Electrical Inspection.

J. P. Barrett is reaping where he has sown. The story of the latest check put upon him is thus told in the *Chicago Record* of March 16th under this heading: "Repudiate city test—Underwriters drop Barrett—Superintendent of the city telegraph will no longer inspect electrical wiring for the association—Cause of the change."

The Chicago Underwriters' association has lost faith in the city electrical inspection which Prof. John P. Barrett supervises. This work belongs to the branch of the fire department known as "city telegraph," of which Prof. Barrett is superintendent. The association no longer considers the certificates issued by Superintendent Barrett's department sufficient for the acceptance of electrical outfits in buildings. Its own force of inspectors hereafter will pass upon all electric light and power wiring and apparatus.

The change is a result of the investigation of Prof. Barrett's office made by the *Record* in connection with the purchase of fire-alarm boxes, which has caused a general scrutiny of the methods of that office by the electrical profession and trade.

Notice of the rejection of the city inspection was given to the electrical trade through the city last week by the following letter sent out by William H. Merrill, Jr., electrical inspector of the National Board of Fire Underwriters and the Chicago Underwriters' association.

Electrical Contractors: I send you herewith some blanks for reporting electrical construction work to this association. Upon closing contracts for wiring which is to be concealed and upon the completion of an installation of wiring entirely exposed to view, kindly fill out one of the inclosed blanks and mail to this office.

Such notices are desired for all work installed by you within the limits of Cook county. Very truly yours,

WILLIAM H. MERRILL, JR.,
Electrician.

This form of letter was mailed to every electrical contracting firm in the city and was accompanied by a number of blanks in which could be filled a description of the electrical equipment of any building, including the street number, occupant, number of incandescent and arc lamps and motors. All work being done in the city will in this way be reported to the office of the electrical inspector, and before the Underwriters' association accepts it as safe for purposes of insurance it will receive the personal inspection of Mr. Merrill's corps of inspectors.

For 13 years Professor Barrett has had the supervision of this work for the fire department. The fire marshal's last report has a record of inspection of 2,899 motors, with 7,824 horse power, 32,661 arc lights, 563,178 incandescent lamps, and 786 plants up to January 1, 1896. The work has kept a force of eight inspectors constantly busy and has been the means of an annual revenue between $7,000 and $10,000 to the city.

The Underwriters' association has depended upon the city inspection respecting much of the electrical installation in the city during that period. Three years ago, however, the work of the Barrett department became unsatisfactory to the association, and a fight was made for the adoption of the rules of the National Board of Fire Underwriters by the Fire Department. The department finally adopted the rules of that body governing the test and inspection of all electrical wiring and apparatus. Since then the association has generally accepted the certificates issued by Barrett's department declaring the safety and efficiency of electrical installations. The department has also made re-inspections, as is required by a city ordinance, it being the purpose in creating the department to prevent fires from electrical causes.

Fires from crossed and poorly insulated wires and other electrical causes, however, have occurred frequently. The average during the last year has been about two a week. The explosion in the *Chronicle* building recently was caused by an Edison wire burning a hole in a gaspipe and igniting the contents, resulting in the injury of several persons and a loss of $3,100. The fire at Central Music Hall Sunday resulted from the crossing of two current wires in the basement.

Last summer a defective joint in the electrical plant of the Wellington Hotel became overheated and set fire to the insulated coating of the wire. Before extinguished the fire had caused a damage of $3,000. A fire in the Twelfth street Illinois Central station last April was the result of a cable grounding on a metal cornice. Blazes in Siegel, Cooper & Co., Morgenthau, Bauland & Co., the Metropolitan "L" power station and S. E. Gross' residence during the year were the results of similar conditions.

These electrical fires proved more frequent than was consistent with the association's ideas of thorough inspection. Complaints against the city inspection had been made. The investigation by the *Record* of the fire-alarm box purchases increased the complaint against Prof. Barrett's administration of his department and raised a question in the minds of the officers of the association as to his competency. The decision to have all inspections made by the electrical bureau of the association is the result.

"The change in our practice of inspection," said President E. M. Teall of the Chicago Underwriters' association, "is an outcome of the question raised by the *Record's* investigation as to the efficiency of the city fire-alarm boxes. Professor Barrett had a dispute with Mr. Merrill, our electrical inspector, and promised to show that he was wrong. He has not done so. When we selected our electrical inspector we selected the best man we could find in the country, and experience has only confirmed our opinion of him.

"We have faith in his views on the fire-alarm boxes, and we have faith in his judgment as to the thoroughness of the city inspection of electrical installation. It has seemed best to have all the inspection under his personal supervision, and then we will be certain that it is well done."

Telegraph Company Must Furnish Quotations.

Judge Gates, at Kansas City, Mo., has issued a temporary restraining order, enjoining the Chicago Board of Trade and the Western Union Telegraph company from denying the W. A. Michael Commission company of Kansas City the privilege of receiving market quotations from the board until further order of the court. Attorney Harkless of the Kansas City law firm of Harkless, O'Grady & Crysler, which represented the commission firm, said that the telegraph company and the Board of Trade had entered into a conspiracy to shut out certain companies and individuals from receiving quotations, which placed the conspirators in the attitude of a trust.

Judge Horton on the same day heard arguments in Chicago upon a motion to dissolve an injunction in one of the cases begun against the Board of Trade and the Western Union Telegraph company, restraining them from discriminating as to whom telegraphic information in regard to market reports shall be given. The complainants in the bill under discussion are Wiley & Co., who have been furnished with market information, and who allege that they have been notified that further information will be withheld and their wires cut off. The court took the motion under advisement at the close of the arguments.

It was reported in Wall street last week that the board of governors of the New York Stock Exchange had encountered a snag in their plan to keep exchange quotations from the bucket shops by depriving them of the Gold and Stock Ticker service. It was reported that Lewis Cass Ledyard, counsel for the board, had advised the exchange that it could not lawfully deprive the outside public of the quotations, if it proposed to serve the members of the exchange. The exchange governors had under consideration a plan to form a contract with the New York Quotation company, which furnishes members of the exchange with the needed figures. The stock of the latter company to the extent of 51 per cent. is owned by exchange members, and the remainder is largely controlled by John W. Mackay of the Postal Telegraph-cable company. Both quotation companies have five-year contracts with the exchange, paying $30,000 a year each for the privilege of sending out the figures. These contracts expire on June 30th, and under the terms of the agreement the exchange is compelled to give 90 days' notice if it proposes to discontinue the privileges. The decision will, therefore, have to be reached by March 30th, and the governors have little time left in which to form their conclusions.

Note on the Voltaic Arc.

A writer in *Wiedemann's Annalen* says that with continuous currents, having deducted the counter-electromotive force, there is little difference whether one employs for the production of the arc electrodes of carbon or of metal. This is not, however, the case with alternate current. According to M. Léo Arons, with alternate currents having a frequency of 100 periods per second and a mean tension of 10 or 12 times that necessary to the production of an arc, it is impossible to obtain an arc between two metallic electrodes, while with carbons of about the same dimensions an arc of more than one centimeter in length and of extreme intensity is easily obtained. Wurtz' deflagrating lightning arrester (1892) is founded on this property of metallic electrodes.

In studying this difference of behavior between metals and carbon three considerations must be kept in mind:

First—Because of their less thermic conductibility the carbon electrodes more readily support a short arc.

Second—While metals do not disengage by volatilization except their proper vapor, all carbon throws off in burning in the electric arc, despite all precautions, a flow of gas which remains as a conductor much longer than metallic vapors, which readily return to the fixed condition.

Third—It has been shown by experiment with electrodes of platinum, aluminum, etc., that oxidation plays an important role in the voltaic arc. With carbon there is little disturbing action, because of the gaseous form of the products of oxidation.

Referring to the researches of Stenger on the counter-electromotive force of the arc, the author draws the following conclusions: The condition of the carbon electrodes and of the gaseous zone after the extinction of the arc is such that an excessive electromotive force is necessary to force a current across this space; it does not act simply as an ohmic resistance, increasing with time, as we are led to believe by a single experiment of Stenger; observations of an inverted arc show that the electromotive force of a battery of accumulators was aided by a counter-electromotive force existing in the arc, which disappeared quite rapidly.

This counter-electromotive force in the space—with the carbons 15 millimeters asunder—measured 10 to 14 volts. (Edlund has found 18 to 27 volts immediately after extinction of the arc.)

Finally the author gives the record of experiments on an arc formed between carbon and metal electrodes. While it is difficult to establish the arc between two metallic electrodes with alternate currents, Jamin in 1882 showed that this was readily done with the two dissimilar electrodes.

With continuous currents a marked difference in the tension was observed, governed by the relative positions of the electrodes in the circuit.

Experiments made at the central station of Berlin showed the following results with combinations of carbon and silver, platinum, aluminum, copper and iron.

Anode.	Cathode.	Length of Arc.	Volts.
Ag	C	7	40
C	Ag	4 5	57
Pt	C	3.8	45
C	Pt	2.3	40-50
Al	C	4	23
C	Al	4	57
Cu	C	7	60
C	Cu	4	60
Fe	C	4.8	40-45
C	Fe	4.8	50

Thus, in employing carbon as a cathode, we see, under identical circumstances and with the same length of arc, as a rule, a tension greater than in the reversed condition. Grove arrived at the same result, using platinum in place of carbon.

Electric Boats in the Sewers of Paris.

It used to be the way that from the Chatelet to La Concorde the sight-seer was drawn in small wagonets by brawny-armed Frenchmen in blouse and wide-hipped pantaloons of blue denim or similar stuff. Since 1894 the complete train has been handled mechanically. But this was not all; the route from La Concorde to the Madeleine by boat was still more laborious for the workmen in the sewers.

Many systems were proposed for rendering the trip more agreeable and easier, among which were helical towing devices, funicular complications, all sorts of pushing and drawing schemes, etc. The method finally adopted was a peculiar chain-boat of M. Bovet's invention, which is actuated by electricity. It is composed in reality of two boats, a head and a tail, separated by the train.

The head boat is made of galvanized iron, and has a rudder, an arrangement for electrical towing comprising a 6,000 watts motor and a pulley with chain, the apparatus necessary for controlling this, and a battery of accumulators with a capacity of 60 amperes for two hours at a tension of 100 volts.

The tail boat, at the rear of the train, is nearly a duplicate of the head, save that its capacity is only one-third that of the former. Two insulated copper wires of four millimeters diameter connect the two motors, which, as stated, are the extremities of a train of passenger vessels. On the latter long settees furnish resting places for the tourists.

The current necessary for charging the batteries is taken at one of the central stations of the city.

This new system of boats has cost the city $4,000, and relieves from the sewer service a blue-blouse troop numbering 57 men, who were formerly required at every trip of the boats to play the rôle of tow-horses; and the trip which formerly required six hours is now accomplished in about two.

The Alley "L" company of Chicago has practically settled on the details of the loop connection. Frontage consents for the ordinance for Harrison street have been obtained and an ordinance authorizing the building of the connection may be introduced at an early date. The question of electrical operation is in the hands of the executive committee, which has already given it much attention in the way of collecting data, etc. Bids for some contracts in this connection will soon be called for. The committee is not yet ready to say whether or not it will recommend that the road build its own power house. It is calculated that to build a connection with the loop will require two or three months, and the electrical equipment will take twice as long.

Enamel Rheostats for Field Magnet Control.

Conceiving that there are serious objections to existing types of enamel rheostats for switchboard use, the American Electric Heating corporation of Boston has brought out a line of dynamo field rheostats which has been carefully designed to secure the best results. Referring to the cuts, Fig. 1 represents the front of the board and Fig. 2 the back of the board.

The rheostats consist of circular cast-iron plates, on which are placed a sufficient number of enameled steel disks containing resistance to provide the necessary number of divisions and total resistance required.

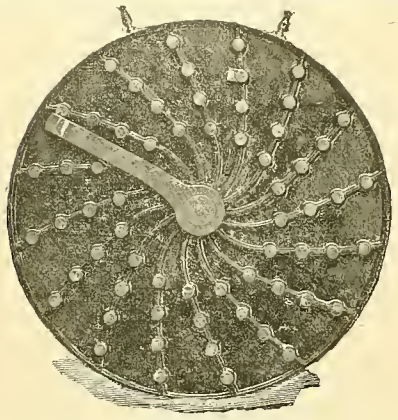


FIG. 1. ENAMEL RHEOSTATS FOR FIELD MAGNET CONTROL.

These disks are of uniform size, but vary between wide limits in resistance and ampere capacity.

The cast-iron supporting plate is provided with suitable holes which permit a single bolt to clamp the connections, disks and plate firmly together, and the bolt heads form the contact points over which the usual movable arm rotates. By this method of placing the resistances one or more rows of contacts may be arranged, thereby distributing the resistance over a greater surface of a given sized plate than has been the practice where all the resistance is located outside the circle of the contact points. In the event of injury to any part of the circuit it would require but a few moments' work of the dynamo tender to locate the fault, remove or cut out the defective part and continue the use of the rheostat instead of having to procure a new rheostat, as would be the case with other enamel types and usually so with the coiled wire forms. The possibility of burnouts is very slight and cost for repairs nominal. No disk can ever have more than its predetermined load, and the factor of safety allowed is large. Each customer can have exactly the rheostat required for his dynamo. Special

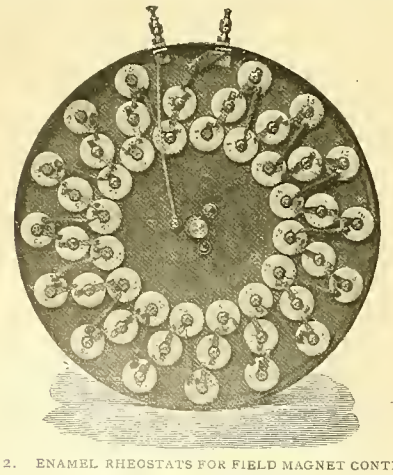


FIG. 2. ENAMEL RHEOSTATS FOR FIELD MAGNET CONTROL.

rheostats within the limits of sizes made can be furnished at once. By reason of there being few sizes of plates required to meet all demands but an infinite combination of resistances, no delay need occur in filling orders, for the average rheostat can be assembled in an hour, and it is a simple matter to keep an assortment of resistances complete.

All field rheostats for mounting on back of switchboard are made so that the holes drilled for one will answer for any size, so if it was desirable at any time to change from one size to another it would involve no change in the supporting bolts or their location.

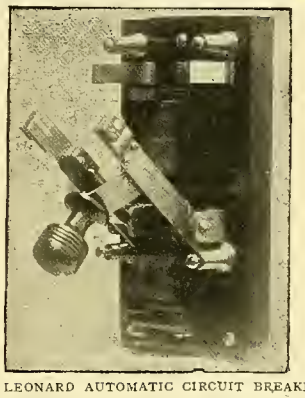
Quite an important feature is that if by carelessness an excessive overload was applied and allowed to remain to the point of causing a burnout, no serious harm could be done, for at most but two or three of the disks could be injured, where the same treatment would destroy other types. The connections are such that the field circuit cannot be opened if the arm fails to make contact.

Field rheostats only are ready for market; but motor starters, regulators and theater dimmers, embodying the same distinctive features, are under way and will be placed on the market soon.

Ward Leonard Automatic Circuit Breakers.

The Ward Leonard Electric company of Hoboken, N. J., has recently placed upon the market a new automatic circuit breaker, which is the invention of H. Ward Leonard, and which possesses many points of merit. This automatic circuit breaker opens automatically whenever the line voltage falls abnormally low, and it also automatically opens when the current becomes abnormally large. The current may fall to zero and even go in the reverse directions, as in elevator practice, and still the switch will not open so long as the electromotive force is normal. This is a valuable feature, and this automatic circuit breaker is claimed to be entirely unique in this respect. If, however, the electromotive force falls too low, showing an improper state of the supply circuit, such as a shut-down at the station or an open circuit in the supply line, the circuit breaker will instantly and automatically open.

The Ward Leonard circuit breaker is double-poled and is provided with a carbon break on both poles. It is entirely independent of position; that is, it will operate perfectly and with constant results in any position. It is also independent of shocks or jars and independent



WARD LEONARD AUTOMATIC CIRCUIT BREAKERS.

of changes of temperature. The overload device can be set readily by the operator to cause the switch to open at any desired amperes, and a scale showing the amperes is provided for this purpose.

This automatic switch, as will be observed by the illustration, is neat in design and very compact. There are no mercury cups, plumb-bobs, triggers, dash-pots, solenoids, or other complicated features which could get out of adjustment. A small push-button enables the operator to operate the switch by hand to open the circuit whenever desired.

It is claimed by the Ward Leonard company that this switch is the only one which is adapted to operate perfectly in connection with electric elevators and incandescent electric lights where the requirement is that the switch should remain closed even when there is no current flowing in the circuit, so long as the electromotive force is normal, and yet should open whenever the current becomes excessively large and whenever the supply of electromotive force fails.

Clymer & Heilman's Products.

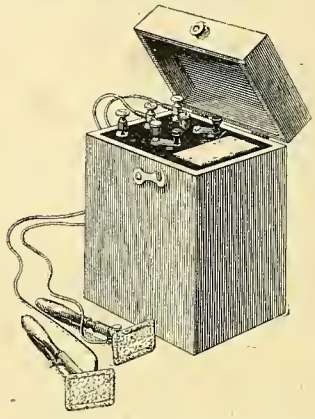
The cuts show a one-twelfth horse power motor and a wooden-box bell made by Clymer & Heilman of Reading, Pa. The motor is of the bipolar type and of compact design, the armature bearings being provided by arms extended from the poles. It is provided with a rocker arm for the purpose of setting the brushes at the non-sparking point, and altogether a good ventilation of all parts is obtained. The magnetic circuit is simple in design and construction, only one spool being used, as shown. These machines are made in all sizes and voltages. They are all reversible. The bells made by this firm, like the motors, are of first-class workmanship and well finished, and give satisfaction in practical use.

The stationary engineers of Winona, Minn., are studying electricity under the instruction of Prof. E. J. Freeman of the Winona Normal School.

Electro-medical Batteries.

Among the electrical specialties manufactured by the New York Accumulator & Electric company of 150 Nassau street, New York, are electro-medical batteries designed for family and surgical use. The accompanying illustration shows one form of these battery outfits. The outfit consists of a highly polished mahogany or oak cabinet, in which are fitted one or more cells of storage battery (of the company's manufacture), sealed in hard rubber boxes, a medical induction coil with hand or sponge electrodes and conducting cords, and the necessary connections for using either the primary or secondary current, or the two combined.

Some of the special features provided with these bat-



ELECTRO MEDICAL BATTERIES.

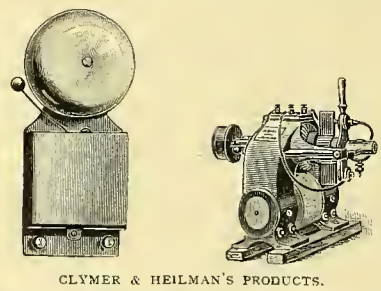
teries are a graduated wire rheostat to regulate the strength of the primary current and a volt indicator—a low-voltage lamp—to tell when the battery needs recharging. The medical induction coil, with the necessary connections, switch device and accessories, is contained in a separate compartment, and is removable without disturbing the battery or *vice versa*. The insulating parts are of polished hard rubber. The metal parts are all nickel-plated.

The outfits for physicians' use have the same general features, but are finer in the details of construction. The battery, too, is of larger capacity, so as to provide for light cautery work and for lighting a surgical lamp.

The superiority of storage batteries over primary batteries for medical purposes is apparent. The renewals of the latter are frequent, troublesome and somewhat expensive, while for storage batteries the necessary renewals—recharging—cost little, the only care required being to recharge the battery when it is exhausted.

Submarine Cable Business in the West Indies.

At the general meeting of the Cuba Submarine Telegraph company in London on February 17th, it is significant that the directors "regretted to report" that a



CLYMER & HEILMAN'S PRODUCTS.

cable had been laid between New York and Hayti in connection with the French company's system, and which had taken that company's traffic from the Cuba company's lines. The president of the company could not say what difference the new cable would make in the receipts of the company, but he was afraid it would be considerable. However, probably owing to the "war news" sent out from unhappy Cuba, a very good business was reported. The president's report recited these facts:

The receipts amounted to the highest figure ever touched in one year during the existence of the company. The receipts for 1895 amounted to £54,116, and for 1896 to £58,635. In 1896 the company had the advantage of the Cienfuegos-Mazanillo cables, which accounted for the difference to some extent. The actual expenses which the company had been put to during the period under review in order to earn gross receipts of £28,681 showed an advance of £1,641, which was almost wholly

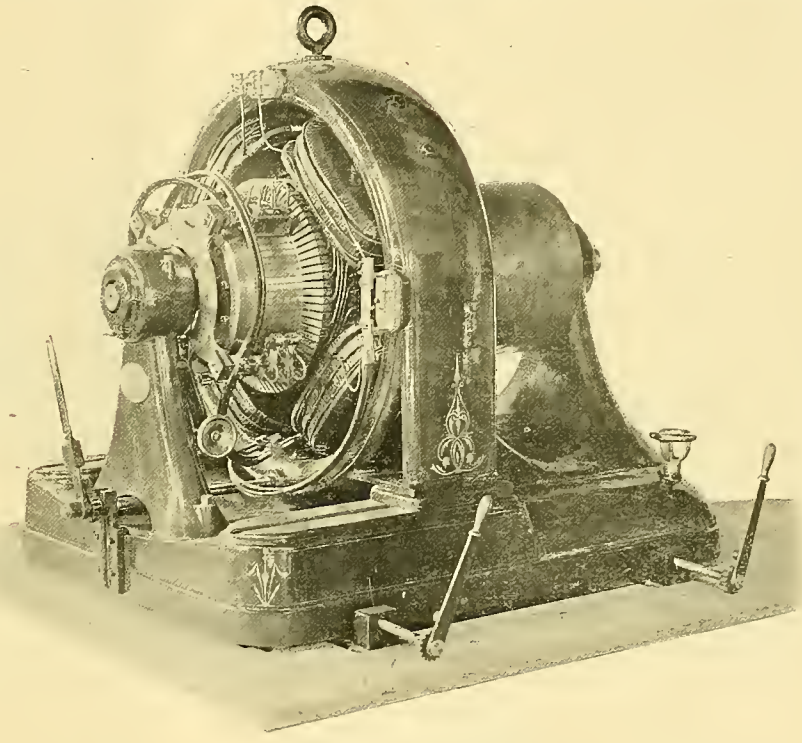
due to expenses at stations, especially those stations connected with the new cable. The new cable had now been at work for 12 months. The ordinary expenditure amounted to £7,180, but they had to add to that three special items which had occurred during the six months covered by the accounts. There were £84 in connection with the International Telegraphic Congress, and there was a special sum of £987 which the shareholders voted to the staff at the last meeting and £100 which the board had subscribed to the Spanish Humanitarian Relief Fund. The sum of £11,000 had been added to the reserve fund, which now stood at £109,000. The dividend on the preference shares would absorb £3,000 and leave £9,499, out of which the directors recommended the payment of a dividend on the ordinary shares at the rate of eight per cent. per annum free of income tax, the balance, £3,099, being carried forward to the current half year. The cables had continued in good order throughout the half year, with the exception of the Cienfuegos-Santiago 1881 cable, which broke down in December, and arrangements are now being made for its repair.

The Western Union Telegraph company announces that it is advised by the Havana (Cuba) office that telegraphic communication with Pinar del Rio is restored.

Improved Generators.

Attention has been called to an article on "Easy Inspection of Large Generators," recently published, which purported to describe certain convenient methods invented by Sidney H. Short of Cleveland, O. It is apparent that one-half of the world does not know what the other half is doing. A correspondent calls attention to a method of facilitating an inspection of the kind mentioned, which is not by any means a new one, as it has been in use for the last three years, and was devised by George F. Card of Mansfield, Ohio. The accompanying cut illustrates an improved generator manufactured by the Card Electric company of Mansfield, Ohio, and represents a novel and convenient method of moving the pole frame and field magnets away from the armature.

The manner in which the pole frame and field magnets are mounted on the base and the convenience it affords for inspecting the armature or field coils can readily be seen. The brackets for supporting the pole frames have tongues cast on them on the under side, which are planed to fit in the grooved slides on each side of the base. On the front of the base is a bracket with a screw, which passes through a nut fastened to the bottom of the pole frame. With the ratchet lever the field core or frame and field magnets can be slid forward on the base, completely uncovering the armature. If it is desired to take the field core or frame entirely from the base, two pieces of timber made level and placed at the end of the base and a crowbar are all the tools necessary. This method is applied to direct-driven as well as belt-driven generators. A number of the Card generators having this particular feature are at present being installed. The armature is supported on three self-oiling and self-aligning bearings; the two at the pulley end are cast together in a very rigid form.



IMPROVED GENERATORS.

Electric Light and Power Plant at Piedras Negeas, Mexico.

The United States consul at Piedras Negeas, Mexico, has forwarded to the State Department a description of the well equipped electric light and power station at that place lately put into operation by the Mexican International Railroad company in connection with its shops. It will be noticed that all of the electrical and mechanical equipment was supplied by American manufacturers:

The building is of white brick, 50 feet eight inches long and 53 feet two inches wide. The main entrance faces the south, there being another entrance on the west side facing the boiler house. The floor level is two feet above the ground level, and is of cement on a foundation of broken stone. The height of the room to the bottom line of the trusses is 16 feet. The roof has a pitch toward the east and west and the rise at the center is 11 feet. It consists of two iron trusses sheathed with wood and is covered with tin. The roof trusses were made by the Wrought Iron Bridge company, Canton, Ohio, and the building was erected by the mechanical department of the railroad.

The designs were made with a view to belting a 200 horse power Ames engine to each end of the line shafting, which is in three sections, the middle section coupling to either or both of the end sections by means of friction clutches. This shafting is of iron and was forged at the shops here. The clutches, pulleys and plummer blocks were made by Wm. Sellers & Co. of Philadelphia, Pa.

At present there is only one engine installed. It was made by the Ames Iron Works of Oswego, N. Y., and is a high-speed automatic cut-off engine, having a cylinder 18 inches in diameter and 16 inch stroke, and has a capacity of 200 horse power at 240 revolutions per minute and 80 pounds initial steam pressure. Its total weight is 20,000 pounds. It has two fly-wheels 78 inches in diameter and 18 inch face, which are belted by means of two 14 inch double leather belts to the two receiving pulleys on the line shafting.

Besides the two receiving pulleys on the line shafting there are three transmitting pulleys belted to two lighting generators and one special power generator for an electric pump.

The lighting generators are continuous current belt-driven machines with four poles and of 25 kilowatts capacity at 675 revolutions per minute, and are compound wound for from 240 volts no load to 250 volts full load. They were made by the General Electric company of Schenectady, N. Y. The power generator for the electric pump is of the same type and style as the lighting generators, having a capacity of 40 kilowatts, and is compound wound for from 500 volts no load to 600 volts full load at a speed of 700 revolutions per minute.

The electric pump consists of a Knowles duplex piston power pump, driven by a 50 horse power electric motor through a train of gearing. The pump has two water cylinders eight inches in diameter and 12 inch stroke, and at a speed of 38½ revolutions per minute has a capacity of 400 gallons of water per minute through 10,000 feet of six-inch pipe to an elevation of 71 feet, or an estimated total head, including friction, of 250 feet. The motor, which was also made by the General Electric company, is shunt wound for 500 volts and has a speed of 575 revolutions per minute. It is bolted to a bed-plate directly above the cross-head guides. The speed is reduced and power transmitted to the crank pins by means of a double reduction gearing, and the crank pins are connected to the pistons by means of connecting rods. The pumping station is situated two miles from the power station, on the banks of the river Escondido. Heretofore the pumping has always been done by means of steam pumps, but the coal had to be hauled by wagon from the side track on the railroad, which is 1,500 feet from the pump house.

The transmission line consists of two No. 00 B. & S. weatherproof wires and one No. 8 B. & S. weatherproof wire. This No. 8 wire is to permit of the motor being started from the power station by means of a starting rheostat. The starting rheostat has an automatic magnetic locking device, by means of which if the motor field circuit should become broken at any time the main circuit will be broken before damage can be done to either the motor or the dynamo.

The wiring for lights is on the Edson three-wire system, and the present installation is about 600 16 candle power incandescent lamps and 24 Thomson incandescent arc lamps. The lighting generators are connected to the outside lines of the lighting system, and the balancing load is regulated by means of a motor-generator set consisting of a five kilowatt 250 volt motor coupled to a five kilowatt 150 volt generator, and this generator is connected to the side of the system which is overbalanced. The main feeders for the lighting system consists of two No. 0000 B. & S. and one No. 00 B. & S. conductors running to a point 900 feet north of the station, where the size of copper is reduced and branches off in three directions. The arc lamps are wired in series of four and the lines are run into the power station so as to be controlled from there.

The switchboard is of marbleized slate, with suitable switches, circuit breakers for each dynamo and Weston round dial instruments mounted thereon. It was built by Eyanson & Armpriester, Philadelphia, Pa.

A 50 kilowatt General Electric slow speed 250 volt motor is to be installed in the foundry, the work of installation being now under way. Power is now supplied by means of a steam engine, the steam pipe running underground and having a length of 550 feet. The circuit for the motor will consist of two No. 00 B. & S. rubber-covered cables placed on a pole line. The lighting generators will supply current for this motor. This motor will supply power for the blower, hoist, rattlers, etc.

The boiler house, from which is now supplied steam to the foundry, carpenter shop, machine shop and blacksmith shop, is 15 feet from the power house and contains three horizontal 75 horse power return-flue boilers, carrying a pressure of 80 pounds per square inch. No additions to this steam plant will be made at present, as it will be of sufficient capacity for the 200 horse power engine in the power station, when the smaller steam engines throughout the shops are replaced by electric motors and the long steam lines replaced by copper cables.

Electricity versus Boiler Scale.

A correspondent of the *National Engineer* lately wrote to that journal to the following effect: "A boiler free from scale and corrosion is greatly desired by all engineers, but is a very difficult thing to attain in practice, although I once had charge of a boiler which, from the day it was installed until another boiler was put alongside it, three years later, never showed any signs of scale on the interior, it always being metallically clean. After another boiler was placed beside it the conditions were changed and it was always a struggle after that to keep the boilers reasonably clean. There was a peculiarity about the first boiler which was that it always seemed charged with electricity when the plant was in operation. The electric charge was so great that sparks fully half an inch long would jump from the boiler to the fingers of a person placing his hand near it. This condition was the more remarkable because there were no electric plants of any kind or electric circuits within a quarter of a mile of the place. Not only was the boiler thus charged, but all connecting pipes were charged to a nearly equal extent. When we put in the second boiler the electricity vanished from the first one and both boilers would accumulate mud and scale to the average extent. I have never been able to explain how the electricity was produced, or what kept it in the boiler, nor how the accumulation of scale was prevented. Other boilers using water from the same source were troubled in the usual way, this one being an exception to the general practice. Rope transmission was used in all parts of the plant, so the electricity could not have been produced by friction of belts, or other similar cause. I have heard that leakage of steam, where the steam strikes against a metallic surface, will cause the accumulation of an electric charge; but there was nothing of that kind in this case. Can you offer any explanation of the phenomenon and explain why electricity (if that was the cause) should keep a boiler free from scale?"

The editor's reply was as follows: "The friction of dry ropes working over wooden pulleys will produce static electricity the same as a belt under certain conditions. A very small amount of electricity is sufficient to cause the decomposition of water—it having been produced by a pressure of less than one volt—and a small amount of water, when decomposed, will furnish hydrogen in contact with the boiler plates which has been found, in some cases, to prevent the adherence of scale forming matter."

Diehl Manufacturing Company's Latest Designs in Ceiling and Column Fans.

The Diehl Manufacturing company of Elizabethport, N. J., maker of the well-known Diehl motors, dynamos, electric fans and arc lamps, has prepared for the season of 1897 a remarkably complete line of electric fans of all types, with many designs suitable for any service. The quality of the Diehl product is shown in the statement of the manufacturers that in every competitive test in which these fans have been entered they have won.

In the accompanying illustrations are shown three of the new fans just placed upon the market by this company. In Fig. 1 is shown a four-blade ceiling fan with a stopping and starting switch. Fig. 2 illustrates an electrolier ceiling fan, and in Fig. 3 is shown a column fan. A counter column fan of the same general design as that shown in Fig. 3 is also made by the Diehl company. The regular finishes of these fans are polished brass, nickel and japan. Special finishes are also produced as follows: White enamel and brass, oxidized copper or silver, antique copper, old brass, rich gilt and light bronze.

The electrolier ceiling fan shown in Fig. 2 is ornamented with solid cast brass work making a very rich and elegant fixture, designed especially for use in the finest restaurants, cafes, club houses and hotels. In the winter time when the fan blades are removed the electrolier makes a very handsome fixture for lighting purposes.

As a rule, all the Diehl ceiling and column fans are so made that the blades will be seven feet 10 inches from the floor. Each fan contains its own motor directly coupled to the fan shaft, and is provided with an improved oil cup and indestructible commutator. The standard windings are as follows: Direct incandescent circuits up to 125 volts, direct incandescent power and street railway circuits up to 500 volts, direct arc current of 6.8, 9.6 or 18 amperes. On 500 volt circuits the Diehl fans may be operated successfully singly or in series of two fans, each wound for 250 volts; three fans, each wound for 170 volts, or four fans, each wound for 125 volts.

The Diehl Manufacturing company has been doing for for some time a large business in supplying slow speed standard motors, directly connected to all the well-known types of blowers. The sizes of wheel used run from 18 inches in diameter to 60 inches in diameter, exhausting from four to 55 6 cubic feet of air per minute. The Diehl motor, on account of its efficiency and slow speed, is especially adapted for this work, in which it is rapidly achieving well merited popularity.

A new catalogue and folder have just been prepared by the Diehl Manufacturing company, describing its air-agitating apparatus, both of which will be sent upon request to anyone interested.

The Centerville, Ia., telephone exchange is to be overhauled and improved in the spring.

Record of Telephone Service.

[From the *Chicago Chronicle.*]

There are many peculiar things about the telephone service of a great city, but one of the strangest is that the greatest number of calls are received at the same hour day after day, that the volume of business slumps off at just the same time every day and that these conditions exist in other cities in proportion to the number of telephones in use.

When the telephone company wants to find out just how business is running, how much work each operator is doing and what is transacted in each station or exchange, it inaugurates a count of every call and answer. This is done on the 10th day of each month, and when the results are compiled a chart is drawn, showing the fluctuations of business, much as the variations in the price of wheat are shown in commercial reports. These charts are filed away for reference and copies are exchanged with the telephone companies of other cities, and they form a most interesting exhibit as indicating the business habits of a community.

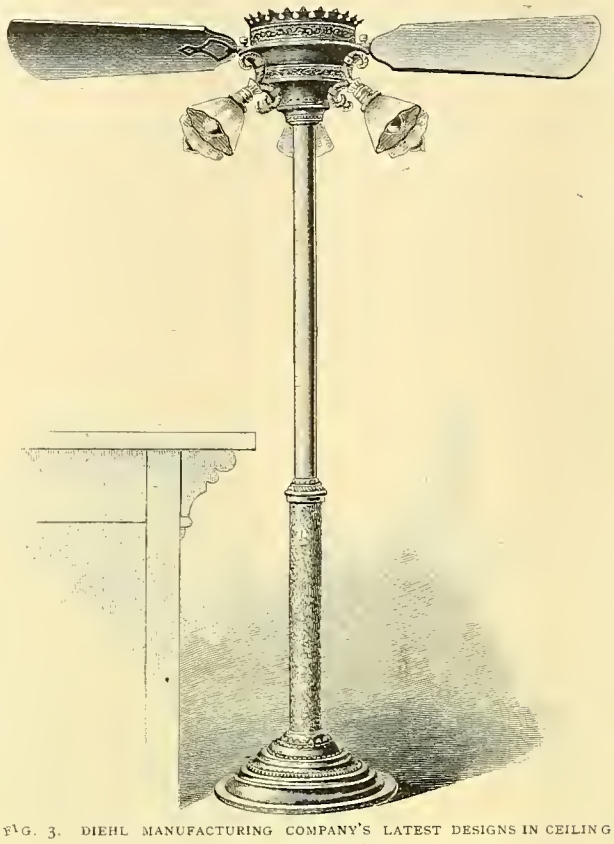


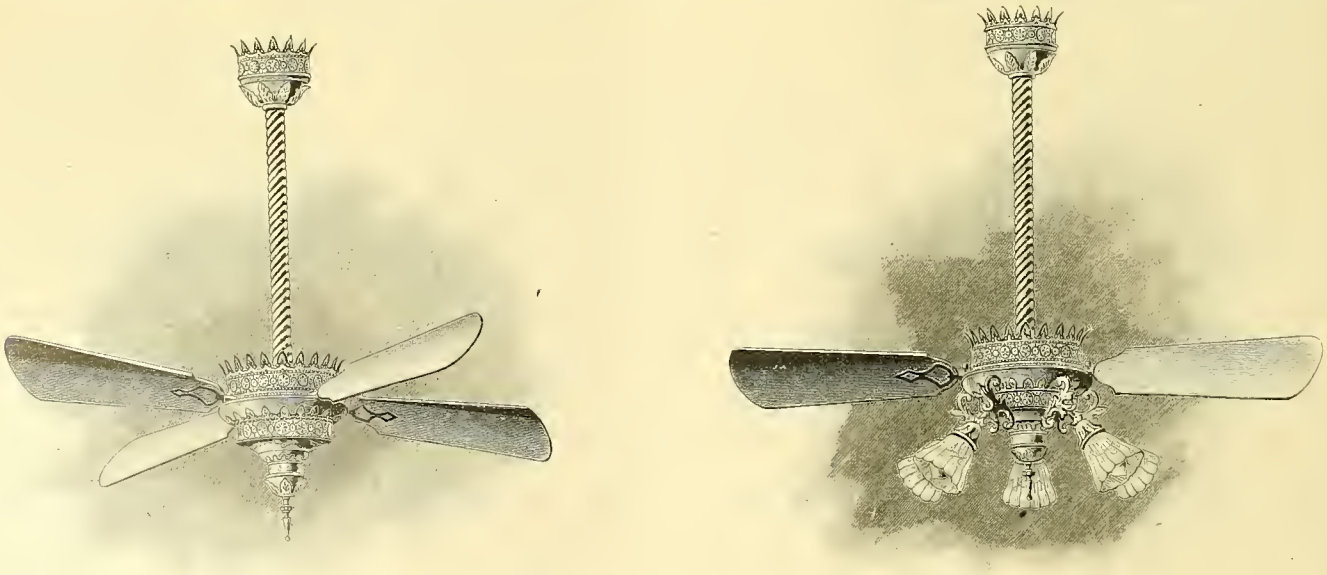
FIG. 3. DIEHL MANUFACTURING COMPANY'S LATEST DESIGNS IN CEILING AND COLUMN FANS.

Nearly every chart on file is the same in general appearance. It is a large sheet of paper ruled to show the hours in one direction and the number of calls in the other, and a wavy line extends up and down the page, starting at the spot designating midnight and ending at the next midnight. From midnight to seven o'clock the line extends across the sheet with scarce a variation, but between seven and eight o'clock it takes an upward shoot to the cross lines designating the 3,000 to 4,000 calls at the main office. But at 10 o'clock it is at its greatest altitude, and between 10 and 11 o'clock is the hour which has the greatest number of calls. Shooting almost directly up from the eight o'clock to the 10 o'clock mark, it shows usually about 10,000 calls for the hour until 11 o'clock. Then it begins to slump off rapidly and at noon the line drops clear down to the 5,000 mark, where it remains until about two o'clock. Then it begins to climb again, until the hour between four and five o'clock, when it indicates business almost as great as that at 10 o'clock in the morning, but after five o'clock the calls dwindle rapidly until six o'clock, and after that the main office does scarcely any business through the night. This is the situation revealed by the chart month after month.

Just why this is so is evident. At 10 o'clock business is at its height in most of the offices and stores of the city. Banks and brokers' offices, courts, lawyers' offices, the Board of Trade and the Stock Exchange and thousands of other business institutions practically begin the day at 10 o'clock in the morning, and then the telephones begin to jingle. Steadily the business increases for about an hour, when the lunch time of the city begins and offices begin to be abandoned. From 11 or half-past until two o'clock the calls diminish so rapidly because the business world is at the trough feeding. Then telephone business slowly mounts up until the closing hours of the afternoon, and just before the ending of the day the business increases again from business men making appointments for the morrow, people telephoning home that they will take dinner down-town and a thousand other causes. After six o'clock the great office blocks and the stores are empty and silent, and through the hours of the night only the newspaper offices keep the girls at central busy.

The chart of the outlying exchanges where the residence telephones are located shows the same peculiarity about the maximum calls at 10 o'clock in the morning, but the wavy line on those charts generally has a higher trend between seven o'clock and eight o'clock in the evening. The Oakland exchange, in which the greatest number of residence wires are, shows a decided splurge of business just before theater time in the evening. Doubtless it is caused in a measure by anxious young men telephoning for carriages to take theater parties down-town or breaking engagements with their best girls. Many Oakland residents order their household supplies by wire every evening from the family grocer, and this, too, has a marked effect on the volume of business.

The exchanging of these charts with companies in other cities has many interesting results. In some places, while the rush hour is always between 10 o'clock and 11 o'clock in the morning, the falling off at luncheon does not begin until 12 o'clock, and the business men do not take so much time to eat, evidently, since business resumes in almost full blast within an hour. Other cities send charts which indicate that luncheon is deferred longer than it is here, but general business continues until six o'clock, an hour later than the average hour here. Altogether the telephone charts with the strange wavy lines are a splendid indication of the business habits of a community.



FIGS. 1 AND 2. DIEHL MANUFACTURING COMPANY'S LATEST DESIGNS IN CEILING AND COLUMN FANS.

The People's Railway company and the Fourth Street & Arsenal company of St. Louis, both of which are in the hands of a receiver, will be reorganized and consolidated by the bondholders. An indebtedness of $240,000 will be paid off, and a new company will be formed, after the bonds and interest coupons have been called in, and bonded for $2,000,000.

Lighting of Crossings with Electricity.

The intent of the Indiana statute of March, 1893, prescribing the duties and powers of common councils of cities in relation to requiring railroad companies to keep and maintain lights at street and railroad crossings in cities, has been held by the Supreme Court of that state not to be substantially different from that of those statutes which provide for other safeguards of various kinds at railroad crossings, and that, under the guise of protecting citizens from passing trains at public crossings, a city is not authorized by it to enter into a general system of street lighting at every point where a railroad track crosses a public street. This, it thinks, would be an unreasonable exercise of the power granted by the Legislature. In fact, it practically says that the statute adds little to a city's power in this regard, for, under the general power to provide, by ordinance, for security of citizens and others from the running of trains through the city, it could require suitable lights to be placed by the railroad companies wherever, on account of the passing of trains over the crossing, the public safety should render it necessary. Under the special lighting statute mentioned, the court further says that the city ordinance could doubtless have required the light to be of a power sufficient to light the crossing, not to exceed that in use in the city; but there could be no authority beyond that to interfere with the company's freedom of contract in providing such electric lights as it might prefer. In short, it holds that in this case the Common Council exceeded the power conferred by the statute, in requiring that the electric lights should be of a certain type, and that there was also an unreasonable exercise of the power granted, in practically providing for street lighting, instead of lights for crossings over which trains run, or are liable to run, at night, and also in not providing definitely for the times during which the lamps should be lit.

Good Showing Made by General Manager Roach on West Chicago Lines.

According to a financial writer in a Chicago publication, earnings of the West Chicago system are increasing in a manner that promises to interest public buying in the very near future. While no small portion of the increase comes in the way of added traffic, the bulk comes in the reduction of expenses, an item, almost incredible as it seems, in which at least $400 a day has been accomplished by the enforcement of economy by the successor of Mr. Parsons, and the indications are that Mr. Roach will make greater savings before he has brought the expense account down to a point where there will be no further saving. Madison street traffic has decreased materially, but the electric lines have increased in business very heavily. Van Buren street cars now make the entire distance to State street via trolley, and cars are crowded. This relieves the traffic on the loop downtown, which is used almost wholly by Blue Island avenue cars. Counting the economies and the increased traffic there is a gross increase in the daily earnings of about $1,000 a day. This assures the dividends remaining at the six per cent. basis, and also the adding to surplus account. The saving in the rate of interest of the consolidated bonds and the debentures to be retired will also add to the economies of the management. There is no question that there is no lack of cash means at the disposal of President Yerkes, and as the electrical improvements are nearly if not completed there should be but little further need for heavy expenditures in this connection.

Electrical "Progress" in Spain.

Through English sources it is learned that the state of the art electrical in Spain goes to show that, however proud and fierce and warlike the Spaniards may be, they lag woefully in exercising the comfortable arts of peace. Two extracts from London technical papers are given:

It is complained in *Madrid Cientifico* that the electric light goes out oftener and keeps out longer in that capital than can be reasonably put up with. The fault (unless for not foreseeing it) does not appear to be so much with the supply company—La Compañia Inglesa de Electricidad—as with the municipality, because the underground conduits which were designed and are maintained by the municipal authorities are in such a condition as to be constantly flooded. *Madrid Cientifico* wants the present conductors changed for paper insulation concentric cables. It might be suggested that a better remedy would be to alter the state of things under which the conduits "are really sewers with a copious flow of water through them."

The Madrid correspondent of the *Times* [London] writes: "The telegraph system throughout this country has always been a crying scandal, and instead of improving with the times and the advance of science it appears to get worse. The most ordinary atmospheric disturbance is sufficient to render unserviceable the greater part of the lines throughout the country, while a heavy fall of snow or a gale of wind generally results in a complete paralyzing of the whole service. Under this condition of things it might fairly be expected that the authorities would not place additional difficulties in the way, and that the public convenience would be to some extent considered; but it it is not so, and the inefficiency of the office is only on a par with the defective state of the *matériel*. Further, the senseless and useless censorship which is exercised by the Home Office, without the slightest discretion being used as to the nature of the contents of the telegrams detained, results in hours of delay. Two telegrams sent to the *Times* within the last week were detained nine hours before they were dispatched."

Important Telegraph Litigation.

A decision was made by the Supreme Court of the United States a year ago to the effect that the Union Pacific Railroad company was obligated to render telegraph service to the United States under its charter, and could not fulfill the requirements of the charter by farming out the telegraph duties to the Western Union Telegraph company. The necessary details to carry out that decree have never been completely adjusted. Now, however, United States Attorney Sawyer has made a motion before Judge Munger at Omaha for the filing of the supplemental decree to the decree originally made by the United States Circuit Court in the case of the United States against the Union Pacific company and the Western Union Telegraph company. The supplemental decree is in conformity with the mandate of the United States Supreme Court in the cases filed in February, 1896.

Judge Munger will set the time when the actual work of separating the Union Pacific and Western Union shall commence. After the order is made, the Union Pacific Railway company, by its agents and employes, and not through the instrumentality of the Western Union Telegraph company, will exercise all the duties created by the telegraph franchise of the acts of 1862 and 1864, and the latter company is directed to vacate all offices of the railway company. The extent of this decision opens the wires, offices and connection of the Union Pacific Railway company to all persons and corporations on equal terms, and destroys the monopoly of the Western Union Telegraph company along the line of the Union Pacific roads. That increases the wires accessible to the Postal Telegraph company alone nearly 2,000 miles.

Electrical Manufacturing in Canada.

In a communication in the *Canadian Electrical News* intended to refute the views of a previous correspondent, who appears to have held that there was no reason for the existence of an electrical manufacturing industry in Canada, a Hamilton (Ont.) manufacturer makes some statements that are of interest to American electrical men. He says, in part:

It is my candid belief that we have men in this country, many of whom working at nominal salaries in our various manufactories, who are in every way qualified to do a great deal in this line if they but had the confidence and support of our manufacturers and would further proclaim their capabilities without "fear and trembling."

While I will admit that it would be useless, with our meager experience and knowledge in this particular branch, to attempt to introduce heavy power transmission apparatus in competition with the highly developed apparatus of American design, yet there remains a great field for perfected constant potential and arc lighting devices, and for the classes of specialties which are always in demand, and because a few large alternators are imported there is no reason why the industry as a whole should be made to suffer in face of a tariff which would result in the flooding of the country with endless cheap apparatus.

There is, of course, no doubt that some of our Canadian-made apparatus is not what it should be. As an instance we can cite the fact that there are not three firms in this country who make a modern and efficient constant potential motor or dynamo; but yet we have not the slightest ground for an excuse for this state of affairs, as we have engineers capable of constructing modern apparatus if sufficient confidence were placed in their abilities instead of undervaluing same.

The few articles entering into the construction of electrical machinery which are of necessity now imported from the United States would soon be furnished if the demand arose for sufficient quantities, and would it not be better to foster such industries, as well as retain the present ones, by guaranteeing sufficient protection, instead of doing the opposite by removing same?

The Trumbull Electric Railroad company of Warren, O., announces that it will extend its line to Leavittsburg within 18 months, the county commissioners having extended the limit of the franchise.

Some Requisites of a Perfect Fire-alarm Box.[1]

By James W. Johnson.

One of the most important details of a fire-alarm system is the street box, which has made greater demands upon the skill of the mechanic and ingenuity of the inventor than perhaps any other appliance used in connection with the fire-alarm telegraph, on account of its location out of doors, where it cannot have the close supervision that the engine house and central office appliances receive, being subjected to extremes of temperature, the effects of rain, sleet and dust, depending for its proper manipulation upon a public that is ignorant of its construction and operation, and with an enemy in the shape of lightning and high-tension currents liable at any time to attempt its injury and destruction.

It is intended here to point out a few of the essential features that should be embodied in all boxes to render them reliable and efficient under the many and varying conditions met with in practice, without making demands upon the inventor and mechanic that they have not already succeeded in supplying; but rather to call attention to necessities that can be readily provided for.

A most necessary provision in a fire-alarm box is to make the hook or lever, by which the mechanism is operated to send in an alarm, easy of access. The so-called "key chase system," which often involves serious delay, is far from ideal. The preliminary steps of hunting up a key and finding the keyhole are chargeable with delays, which may be entirely overcome by using an efficient type of keyless door. As the question of doors is one that would require a paper in itself for proper discussion, this feature will not be treated at length here.

Where cost is not an important factor, the type having a gong inside, which is sounded when the handle is turned, thus giving a local alarm and assisting in the detection of persons attempting to send in false alarms, possesses advantages over other kinds.

A very efficient type consists of an ordinary key door, having an opening covered by glass, upon breaking which access may be had directly to the hook without opening the door at all. Such a door requires that the hook be constructed so that it cannot suffer injury in breaking the glass, and provisions for preventing the entrance of rain and dust to the interior case when the opening in the outer door is uncovered.

The ideal fire-alarm box should be so constructed as to insure the repetition of its signal the proper number of times whenever the hook is pulled, and to prevent the signal from being affected if the hook happens to be pulled again before the signal is completed; in other words, when the mechanism is once started it should be impossible to affect its operation by means of the hook until the whole signal has been transmitted.

It should be absolutely non-interfering, by which is meant that should two or more boxes happen to be pulled simultaneously the signals from every box will be transmitted without the slightest confusion or interference.

Its mechanism must be so designed and constructed as to be absolutely reliable under all conditions of practice unaffected by extremes of temperature or by frost or dust to such an extent as to affect its operation, if given a reasonable degree of care.

It must have efficient protection against lightning and high-tension currents, and the devices or appliances whereby this is accomplished must be so designed and constructed as to leave the box in good operative condition after they have performed their functions of protecting it.

The best modern practice is to shunt or short-circuit the signaling contacts and box magnets, or to switch them entirely out of circuit when the box is not in use. If the shunt circuit is of sufficient carrying capacity this method has advantages over the other, because it is not necessary to rely upon the operation of a spring or the box mechanism and it allows the contacts to be kept closed normally, which keeps dust from accumulating on them; whereas contacts held normally open corrode and become dirty and often miss the first blows. A slight fusion of the contact points where a switch is used may prevent the spring from drawing it over, or the spring may become weakened and fail to act, either of which would render it impossible to send in an alarm from the box.

The most efficient and reliable device now employed consists of two contact points of large carrying capacity and low resistance, one of which is attached to the starting lever or sector, and the other to the framework of the mechanism in such a way that when the mechanism is at rest the contacts are held firmly together, whereby the shunt circuit, consisting of wire of ample carrying capacity, is closed, and the signaling contacts and magnets thus cut out of circuit.

By this arrangement the person pulling the lever or hook of the box draws one of the contacts away from the other, and the power exerted in pulling the box is ordinarily sufficient to pull the contact points apart, even though they may have been somewhat fused.

In all fire-alarm boxes the signaling contacts and magnets should be cut out from the main circuit when the box is not in use, and the means for cutting them into circuit should not depend upon the operation of the mechanism or of any spring, but upon the physical force exerted by the person in pulling the hook.

The clockwork mechanism, as well as the signaling contacts, should have the best possible protection against entrance of moisture or dust; but as it is impossible to wholly eliminate dust, the mechanism should be designed so that it will not be rendered inopera-

1. Read before the annual meeting of the Illinois Firemen's association, at East St. Louis, January 14, 1897.

tive even though a certain amount of dust accumulates upon it.

The mechanism should be self-restoring; that is, it should be constructed so that it will bring itself into signaling condition at the end of each completed signal without the necessity of any manual performance, such as closing the door.

It must be simple. It must not have a multiplicity of contacts. Aside from the telegraph key two sets are all that is necessary—one for the signaling and the other for cutting the box out when not in use—even in the most efficient types of non-interfering boxes. It must have means for signaling manually for the use of the officials of a fire department in communicating with the engine house, and also means whereby the box can be thoroughly tested, mechanically and electrically, without calling out the department. The ideal fire-alarm box must be one that can be grafted into systems already established without detracting from the efficiency thereof in the slightest degree; but, to the contrary, it should be a box, the introduction of which will, if anything, better the system and render it more reliable and efficient.

The signaling contacts should be constructed so that an accumulation of dust will not cause false blows or failures, and so that the contact surface will always be kept clean.

The form of contact that has given the best practical results in actual service consists of two flexible springs, into the free ends of which are riveted the contact points. These springs are mounted so that the number wheel of the box controls them, and when the circuit is closed the contact points come together at the edges, and then move against each other as the operation of closing the circuit progresses. As there is some pressure and friction between them any particle of dust will be cleaned off and a thoroughly good connection is bound to be made.

The non-interference device should also be mechanically restored by the mechanism, and not be dependent upon the co-operation of the outer door or other manual means. It should, moreover, be so much under the control of the mechanism that the magnets will have nothing further to do than to hold the armature in place after it has been put there mechanically; otherwise a reduction in the strength of the line current would be very apt to render it inefficient.

A perfect box should, moreover, be so constructed that it can be auxiliarized and operated from an auxiliary box without rendering the non-interference device inoperative.

Special stress is laid upon the necessity of having the box absolutely non-interfering. There are fire-alarm boxes called non-interfering boxes that are only partially so. Two of them pulled exactly together will interfere every time, and under certain other conditions interferences occur. A box of this kind that may in an emergency fail to do what it is expected and designed to do may cause serious consequences sometimes, and its chances of failure should be thoroughly understood and provided for. There was a time when it was thought impossible to make an absolutely non-interfering box—one that could be depended upon under all conditions of practice to prevent the loss of alarms and interference, but such is not the case at present.

The perfect fire-alarm box should be non-interfering to such an extent as to absolutely prevent confusion or the loss of any signals from attempting to send two or more over the same circuit simultaneously under any and all conditions.

Large Electric Mining Plant in California.

The important electric power plant in course of construction on the Amador side of the Mokelumne river, at Blue Lakes City, will be completed by the end of March. The following facts in relation to this plant were gathered by the *Engineering and Mining Journal* from a recent report of the general manager of the California Exploration company. The surveys have been made for the power and light line, and poles are being erected and transmission wires laid. The system will embrace 33 miles of mines, from Plymouth, in Amador county, to Altaville, Calaveras county. Already contracts have been made with the California Exploration company, which controls the power in Calaveras county, to furnish light and power to the towns of San Andreas and Mokelumne Hill, and the adjacent mines. The supply of water needed to generate the power will be taken from the Great Lakes at the summit of the Sierras. It is estimated that, if necessary, 300,000,000 gallons of water per day can be supplied from these lakes. Large reservoirs have been constructed at Slabtown, two miles from Blue Lakes City, and excavating for a trench 3,400 feet in length for the reception of the power plant pipe line has been completed. This trench has been sunk to the bedrock and in some cases it was necessary to cut into the rock for a depth of 20 feet. The first section of the pipe has been laid in place. As it is laid it is bolted together; it then is secured in a mass of concrete, which method of laying it will be continued for quite a distance up the line. In addition, the trench is filled with good material, well rammed into place about the pipe, so as to amply secure it against any possibility of movement caused by the enormous pressure to which it will be subjected when in operation, as it will have a fall of 1,043 feet at the power house, developing 2½ horse power for each miner's inch of water. This part of the work especially is receiving much care and no expense is spared to make it a substantial and permanent construction. The pipe itself is made of the best material throughout (steel), at the lower end one-half inch in thickness, and is 22 inches in diameter. Every piece is tested at the factory before shipment to double its working pressure. The pipe line construction will be pushed to completion and will be ready within the contract time.

The power house building is a substantial steel-frame structure 35 by 100 feet in the clear, containing a 10-ton traveling crane; it is covered with corrugated steel sheeting and lined with asbestos and tar paper to prevent condensation. It is erected on substantial stone foundations, laid in cement mortar and carried down to solid bedrock. This building is now completed and ready for the reception of the hydraulic and electric apparatus. The preliminary installation of the latter will consist of two 750 kilowatt two-phase Stanley generators, one of which has been shipped, while all of the apparatus will leave the factory in March. Commodious camps have been established and a large force of men is at work. Some new and valuable improvements are presented in the water-wheel plant, which will consist of three 800 horse power wheels of a new type, which are now being manufactured in San Francisco; and the equipment will be ready by the time the generators arrive. From this power house as a central station power will be supplied to a number of mines owned by the company, as indicated above.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 13.—When the State Railroad Commission met on Wednesday to consider the application of the Metropolitan Street Railway company for permission to change the motive power on the Sixth, Eighth and Ninth avenue lines to the trolley conduit system, the board was asked to withhold the desired consent by a lawyer representing the Third Avenue Railroad company and others, who contended that the consent of the Board of Electrical Control should have been secured and who asserted, also, that the Metropolitan company, by reason of its inactivity under original grants, was a trespasser on some of the streets affected. In his reply for the Metropolitan company, William C. Whitney said: "We are prepared to spend $5,000,000 or $6,000,000 and to build two parallel lines near the backbone of the island to try and relieve the tremendous glut of travel. We have got to begin the work at once, if we are going to do it. We intend to build 2,000 feet a day, which is tremendous work. The property-owners are clamoring for the change. The Eighth avenue property-owners want us to come down their avenue and not stop at Fifty-ninth street, and I have no question in my mind but that we shall go down Eighth avenue. We offered some time ago a reward of $100,000 for the purpose of stimulating invention in connection with motive power for surface railroads. We have secured now, in the face of almost insuperable difficulties, what is considered the best method available, and we desire to give the public the benefit of it, and improve the service on street railways, and we are met on every side by a host of preposterous objections." The Metropolitan company's engineer, F. S. Pearson, explained the trolley conduit system. He said that it was greatly superior to the cable, as it was cheaper, and any number of cars could be run with safety over any part of the line. The system had proved successful on Lenox avenue, he said. After Mr. Pearson's statement, the opposition of the other railroad companies to the character of the motive power was withdrawn. Other legal objections were raised, however, and the hearing was closed without a final decision. The commission will meet again on Wednesday. The opposition of the Third avenue company seems to be wholly factitious. The public is friendly to neither company, as the service is bad. As the *Herald* says, "Probably nowhere else in the world would such a shameless defiance of public convenience be tolerated for a day."

The Brooklyn bridge trustees have decided that "L" trains and trolley cars may run across the structure if their owners make proper compensation for the privilege. There are no engineering difficulties in the way. Superintendent Martin says that the stability of the bridge will not in the slightest degree be endangered by the substitution of "L" trains for a part of the bridge trains and by the introduction of surface cars upon the roadways.

The horseless carriages will make their first appeal to the New York public within a short time. It is proposed to put 12 of these vehicles on the streets. They will be hansoms and coupes. The motive power will be electricity, and it is promised that the new vehicles, with their pneumatic tires, will be more comfortable and less noisy than the ordinary cab. However, a writer for the *Sun* apprehends that "It will take some composure to ride about in these new horseless carriages. They are certain to make their passengers conspicuous, and they might not survive this drawback coupled with the reputation of cheapness."

At the recent annual meeting of the New York & New Jersey Telephone company, the following-named directors were elected without opposition: Charles F. Cutler, Alexander Cameron, Joseph P. Davis, Charles A. Nichols, Hugh Kinnard, William D. Sargent, David B. Powell, George H. Prentiss, Joel C. Clark, Felix Campbell, Edward J. Hall and Henry Sanger Snow. The treasurer's report contained the following items: Gross earnings, $1,554,585.33; expenses, $1,076,854.76; balance on hand over and above operating expenses, $477,730.66; interest and taxes, $107,268.72; new earnings, $370,461.94. Of this, $253,363 was set aside for dividend purposes, leaving a surplus for 1896 of $117,098 94.

The Western Union's (partly estimated) statement for the quarter ending March 31, 1897, shows net revenues for the quarter of $1,100,000. From this interest on bonds, $223,358.70; sinking fund, $20,000; in all, $243,358.70, with the requirement for the dividend which has been declared, at 1¼ per cent., $1,191,691.25, makes $1,435,049.95. The surplus at the end of the December quarter, $7,906,041.49, is reduced to $7,570,721.54. The quarter has been one of unusual dullness of business and the results markedly out of line with the usual and normal earnings, being some $445,000 less, in net, than for the preceding quarter. However, a prompt betterment is expected. M. S.

Milwaukee, Wis.

MILWAUKEE, March 13.—The North Greenfield & Waukesha Electric Railway company has been incorporated for the purpose of building an electric line from North Greenfield to Waukesha. The formation was something of a surprise in street railway circles. The Milwaukee & Waukesha Electric Railway company, which owns the Wauwatosa dummy line and has a franchise to build lines into Milwaukee, has laid out a line running from its terminus at North Greenfield to Waukesha.

It is not likely that both lines to Waukesha will be built, as they would necessarily run side by side the whole distance, and the chances are that the line that is built first will have a monopoly of the field. The incorporators of the new company are Stutley I. Henderson, a real estate agent of this city with interests at North Greenfield; F. W. Henderson and S. M. Williams, attorneys of this city; August F. Lindow, another real estate agent, and Walter K. Means, a civil engineer. The capital stock of the company is $100,000. It is safe to say that the gentlemen who have incorporated the company are not going to put up the money to build the proposed road, which they say will be done this year. Stutley I. Henderson, one of the incorporators, has hitherto been associated with the Wauwatosa dummy line people, but as they have incorporated the Milwaukee & Waukesha Electric Railway company, it is hard to imagine why it should be necessary to organize still another company to carry out their plans. Upon the face of things it does not seem as though the new move boded well to the original Waukesha company. On this account and because of the fact that the Milwaukee Electric Railway & Lighting company's line now terminates at North Greenfield, it is suspected that the new company may be working in the interest of the Milwaukee company, so as to freeze out its prospective rival.

The engines for the power house of the Citizens' Traction company at Oshkosh are to be ready for use on May 15th. They are of the Hamilton-Corliss type. The buildings erected by the company are about completed, and the time before May 15th will be spent in getting the machinery and cars in order.

The talk of utilizing the dells on the Wisconsin River for power in the production of electricity has been revived, the idea this time being to make the current furnish the means of propelling cars on a line to be built between Kilbourn and Baraboo.

The Menominee River Boom company has some idea of utilizing the power of Chappe Rapids. A survey has been ordered, and if it be shown that there is a 12-foot head at the rapids, a large dam will be built, and the power conveyed to Marinette, a distance of six miles, by electricity.

The village board of Delavan has granted a franchise for an electric railway line, to be built by the Delavan Light & Fuel company, between the town and the summer resorts on Delavan Lake. The franchise is to run for a period of 20 years.

The Milwaukee Electric Railway & Lighting company

has submitted an interesting statement to the New York Stock Exchange and it has found its way into the hands of the Wisconsin legislators. The statement values the company's property at $14,223,150.66; supplies on hand, $52,905.92; consolidated bonds deposited to retire Milwaukee City Railroad first mortgage bonds, $1,000,000; consolidated bonds to retire West Side railway first mortgage bonds, $500,000, and other items, the grand total being $15,888,526.89. The preferred stock is $3,500,000; the common stock is $3,500,000; consolidated mortgage bonds, $7,000,000; Milwaukee City Railroad company bonds, $1,000,000; West Side railroad first mortgage bonds, $500,000; mortgage on Milwaukee Arc Light company plant, $20,000, and other items, making the grand total of $15,888,526.89. The company is understood to be in a very satisfactory condition. It is paying interest on its bonds, although it does not appear to have paid any dividend yet.

The state tax paid by the Wisconsin Telephone company on its business during the last year was $9,274.90.

It is stated that the Pabst power house plant and system would not have been transferred to the Milwaukee Electric Railway & Lighting company if the terms of the original option had been adhered to. The New York directors of the Milwaukee company experienced more trouble in raising the money than they had apprehended and the option expired before they could make the necessary payment. Capt. Pabst, however, not only gave the company more time in which to make the purchase, but accepted the old street car barn property on West Water street, near Grand avenue, in part payment of the purchase price.

At the instance of some of the Milwaukee aldermen the police department "kept tab" on the Milwaukee street car lines for six days during February, in order to ascertain whether the company was complying with the ordinance to regulate the running of cars on the various lines. After the test the chief of police reported that on only one line, the Wells street branch, was the headway called for by aldermanic enactment maintained. It has also been reported to the council that the company is still using some cars that are not provided with vestibules, although the limit provided by the state law for building vestibules on street cars expired some time ago. Some of the aldermen are threatening to make it very interesting for the company in the courts. C.

PERSONAL.

T. W. Ness, representing the Holtzer-Cabot Electric company of Boston, was in Chicago last week.

H. J. Gille, who represents the Washburn & Moen Manufacturing company in St. Paul, Minn., was a recent Chicago visitor.

Henry B. Cutter, president and general manager of the Cutter Electrical & Manufacturing company of Philadelphia, stopped in Chicago on his trip through the West.

Last week's out-of-town callers at the office of the National Electric Light association in New York were: C. S. Knight, Fort Wayne, Ind.; D. D. Dickey, Pittsburg, Pa.; W. C. Ballda, Utica, N. Y.; J. Wilson, Boston, Mass.; Samuel Insull, Chicago, Ill.; J. J. Burleigh, Camden, N. J.; H. Brooks, Boston, Mass.; E. F. Phillips, Providence, R. I.; H. C. Adams, Jr., Pawtucket, R. I.

Friends of F. B. Badt, secretary of the Siemens & Halske Electric company of America, will be grieved to learn of his recent bereavement. Professor Badt last week was informed of the death of his mother in Germany. The deceased was 72 years of age and had been ill only a short time. The immediate cause of death was pneumonia, which developed from an attack of *la grippe*.

A recent biographical sketch of Ferranti, the great investigator and demonstrator of high-tension electrical transmission in England, gives the information that, in spite of his Italian name, he has comparatively little Italian blood. Of his grandparents, one was American one English and one Flemish. As far as descent goes, therefore, America has as good a right to claim him as Italy has.

Prof. Simon Newcomb, the great astronomer and mathematician, has retired from the navy and superintendency of the Nautical Almanac. A recent writer, dwelling on Prof. Newcomb's achievements, asserts that "he has done more than any other American since Franklin to make American learning respected and accepted in European countries. To-day every astronomer in the world uses Newcomb's determinations of the movements of the planets and the moon; every eclipse is computed according to Newcomb's tables; every nautical almanac is based on the determinations of the Washington office, and the shipping of the civilized world is guided either by the American Nautical Almanac or by ephemerides based on Newcomb's work."

ELECTRIC LIGHTING.

The Raleigh, North Carolina, Electric Light company will rebuild its electric plant, which was burned last summer. The plant will cost $35,000 or more.

The Eaton, O., Electric Light & Ice company has been given a new contract for street lighting. The new system will consist of 160 thirty-two candle power incandescent lamps operated for $21.50 per lamp per annum. Arc lights are used at present. The company will have the new system ready about April 1st.

The Pikesville, Reisterstown & Glyndon Electric company has been incorporated, with a capital stock of $25,000, and purposes distributing electric lights for the Maryland towns mentioned in its title. The incorporators are Edmund T. Mudge, Henry L. Naylor, Arthur A. Rich, Frank Della Torre and Randolph Barton, Jr., all of Baltimore.

ELECTRIC RAILWAYS.

The annual meeting of the Metropolitan West Side Elevated Railway company will be held in Chicago at the office of the company on April 5th.

It is said that Samuel B. Sneath, owner of the uncompleted Tiffin & Fostoria electric railroad, has decided to continue the work on the road. A greater part of the 14 miles between Tiffin, O., and Fostoria has been graded, and over a portion of the distance the rails have been laid.

It is stated that the arrangements for the $3,500,000 loan for the Northwestern "L"—the elevated electric railroad building on the North Side, Chicago—are practically completed. It is estimated that this sum is sufficient to complete the road, which will now be built as soon as possible.

The Falls Road Electric company of Baltimore is about to begin work in the city and suburbs. Its line is to be double track and seven miles long, with one or two branches. It is understood that 80-pound rails will be used. Plans are being prepared for a car shed, to be erected at Mount Washington, the present northern terminus of the road. This building will be 80 by 200 feet, and will accommodate over 50 cars. Geo. R. Webb, Equitable building, Baltimore, is general manager of the company.

The Bluff City Electric Street Railway company, connecting Waukegan and Evanston, is endeavoring to secure the consent of the Lake Forest, Ill., Council for right of way through the latter town. The route selected enters Lake Forest from the north in Railway avenue. At Wisconsin street it turns into Depot avenue, running by the Northwestern railroad station and through the business center to Illinois street. There it is proposed to run through the subway under the Northwestern tracks to Western avenue.

At a meeting of the stockholders of the Reading & Boyertown Electric Street Railway company the following-named officers and directors were elected for the ensuing year: President, Jeremiah Hagenman; secretary, M. G. Taylor; treasurer, Dr. T. J. B. Rhoads; directors, Dr. T. J. B. Rhoads, M. G. Taylor, C. B. Spatz, J. Hagenman and F. P. Esterly. The road, starting from the tracks of the Pennsylvania & Reading railroad at Boyertown and connecting with the East Reading road at Black Bear, will be built this spring. The capital stock is $300,000.

A new electric railroad is said to be an assured fact from Joliet, Ill., west through Kendall county, to some point on the Fox river, the objective city being as yet undecided upon. A meeting was held at Newark, Kendall county, recently, to discuss the situation, and a competent engineer and a capitalist have been on the ground. It is proposed to have an electric railroad to carry passengers and freight. A rich agricultural country between the Rock Island and the Chicago, Burlington & Quincy is not touched by railroads. The farmers of that territory are anxious to get connection with the outside world.

The application of the Catskill Electric Railway company for permission to build a line from the water front at Catskill-on-the-Hudson to a point in front of the Grant House in Jefferson county was heard by the railroad commissioners at their recent meeting in New York. The commissioners also considered the application of the Auburn & Western Railroad company for permission to build an electric road between Auburn and Seneca Falls, a distance of 10½ miles. The application was opposed by counsel representing the New York Central & Hudson River Railroad company, and the hearing was adjourned until the meeting at Syracuse.

It is reported at Denver, Colo., that an electric railway to operate in Summit and Park counties will be built for the purpose of furnishing transportation facilities to mining camps which have been shut out of the market owing to the high price attendant on existing means of hauling, the only system that has been hitherto available being by aerial tramways and pack animals. These means have proved so costly that many mines have had to shut down. The line will start at Alma and Breckenridge, where connection may be had with the South Park railway leading to the Denver smelters. It is estimated that the electric line can handle 200 tons a day at a cost of not to exceed $1 a ton. Water powers will be utilized. M. M. Howe, an experienced mine manager, is at the head of the project and with him are associated J. P. Pierce of Buffalo, Judge Hibbard, Paul Marker and W. F. Fox of Chicago, J. W. Boone of Syracuse, Henry Clews of New York and Melville E. Stone of Chicago. The road will cost about $100,000 and will be in operation by the middle of September.

MISCELLANEOUS.

It is stated that a large firm manufacturing dynamos and motors is at work upon a motor that will run at a speed of 10,000 revolutions per minute. This motor, if it can be successfully constructed, will be used by the United States government on men-of-war to start the propelling machinery of Howell torpedoes just before they are fired from their tubes. This torpedo is propelled by the energy stored in a small fly-wheel inside of it, made to revolve at a speed of 10,000 revolutions, and at present a steam turbine is the only motor of simple form that is available to rotate the fly-wheel at that speed.

In noting an addition to a review of the electrical progress of 1896, by C. G. Armstrong, which it had previously published, the *Canadian Engineer* mentions the "curious coincidence that on the same day this article appeared in the *Canadian Engineer* the WESTERN ELECTRICIAN of Chicago published a review of the electrical developments of 1896, under the same title, and by a writer of the same name (C. G. Armstrong), and further, that the Chicago writer, though dealing with local events, comes to the same conclusions on many of the problems of interest to the electrical world."

The annual convention of the National Association of Credit Men will be held at Kansas City, Mo., on June 9th, 10th and 11th. The National association was organized in the spring of 1896 and held its first annual convention at Toledo, Ohio. With less than a dozen local associations, there were 150 delegates at Toledo. There are now over 30 local organizations in the principal jobbing centers and others are rapidly organizing. It is expected that there will be at least 50 local associations when the annual convention is held in Kansas City next June, and from the unusual interest manifested it is expected that fully 600 delegates will attend the second annual convention.

TRADE NEWS.

The plant of the Jenney Electric Motor company of Indianapolis was badly damaged by fire last week. The main building was destroyed, with its contents, but the power house and testing department were not destroyed. The company will probably rebuild at once.

Captain W. L. Candee, general manager of the Okonite Wire company of New York, left on Saturday for a short trip to Bermuda for his health. Without doubt, ere his return, the natives of Bermuda will have become well acquainted with the merits of Okonite insulation. The many friends of Captain Candee wish him a pleasant trip, and hope that after the needed rest he may return much benefited.

The General Electric company's new catalogue of "Electric Pumping Machinery" ranks creditably with the other printed matter of the company as an example of book-making and contains much valuable information. Many typical equipments are illustrated, and the various types of pumps and motors are shown in combination. The work will be found to be a valuable addition to the working engineer's books of reference.

General Manager W. C. Ballda of the Utica Electrical Manufacturing & Supply company of Utica, N. Y., was a visitor in New York city last week, spending several days on business in connection with his concern. He reports that they have about all they can do in their factory, and that the outlook is improving. The company has recently taken a number of large contracts, and from all indications there will be a very busy season in the vicinity of Utica in the electrical business.

The Metropolitan Electric company of Chicago has taken the agency for a line of desk lamps covering a number of different styles of adjustable stand lamps, pivoted portables, roll-top desk lamps, bracket lamps and adjustable ball hangers, all with the most approved shades in different finishes. A good desk lamp is a matter of interest to every office man, and in the illustrated circular being issued by the Metropolitan Electric company will be found a complete line of well assorted desk lamps that commend themselves to the public.

The Standard Paint company is still in business and claims to be selling more P. & B. than ever. "We are pleased to report a most gratifying increase in the sale of P. & B. insulating compounds and armature varnish," writes General Sales Agent F. S. De Ronde from New York, "particularly among street railways and manufacturers of electrical machinery. We invite correspondence from electricians and electrical manufacturers everywhere, and will take pleasure in answering any questions regarding our goods and will cheerfully furnish samples and all information if desired. We also make a specialty of roofing for central stations and car barns. We particularly invite correspondence on the question of how to roof buildings."

The Central Electric company states that the prospects for business are exceedingly promising. The inquiries for its numerous specialties are daily increasing, which gives evidence that customers are providing for a

lively trade. It is quite evident that the Wagner direct-connected alternating current ceiling fan motor, for which the company is general western agent, is bound to be a winner. It has many and unusually advantageous features, which seem to appeal to prospective users with unusual force. The Central company is bringing out a new form of spark arrester made entirely of Russia iron, and adapted to be used in connection with most any form of arc lamp. Circulars fully describing this device are being sent out, and will be sent on application.

The Washburn & Moen Manufacturing company has just sold to the New York, New Haven & Hartford Railroad company for its new electrical equipment at Berlin, Conn., a large number of the new "Crown" rail bonds. These bonds are to be stranded, are something more than 300 000 circular mils capacity and are to be applied under the rails, two bonds to each joint. Col. N. H. Heft, chief electrician, has had a large experience in such matters, and thoroughly appreciates the merits of a good bond. The Crown bond has also just been sold for the equipment of the Lorain & Cleveland railway and to the Brockton, Bridgewater & Taunton Street Railway company. This bond is made in different shapes, so as to meet all conditions of rail bonding, and is proving very attractive to street railway superintendents and managers.

"Our works are being run full time; the prospects for future business are all right, and we are satisfied that the year will be one of the best we have had in our business," was the cheering greeting given by Treasurer A. H. Blackburn of the Fuel Economizer company of Matteawan, N. Y., to a representative of the WESTERN ELECTRICIAN recently. In reply to a question, if the West was well represented in the orders which had been secured by his company, Mr. Blackburn stated that its best business for some time past had been from western territory, and that the following orders were recently taken: Two thousand horse power economizer for installation in the plant of the Salinas Beet Sugar Refining company, California; De La Mars Nevada Gold Mining company of Salt Lake City, apparatus for 600 horse power; Anheuser-Busch company, St. Louis, 1,000 horse power economizer. One thousand horse power is now going through the works for the Armour Packing company, Chicago—this being a duplicate order; also a 2,000 horse power economizer for the Edison Electric company, New Orleans.

BUSINESS.

Testimonials for Alcatraz electrical compound continue to be received by General Agent C. P. Williams of 39 Cortlandt street, New York, showing that many severe tests are made of this well-known compound. A recent letter from E. H. Clark of Long Branch, N. J., was accompanied by a section of moulding and wire which had been covered with Alcatraz that had passed through a fire recently. The samples were in excellent condition, and amply demonstrated the truth of the statement that this compound is fireproof.

The Lombard hydraulic brake for street cars is operated on the principle of the well-known Lombard waterwheel governor, and is said to be the best brake made. A description is given in a pamphlet issued by the Lombard Hydraulic Brake company of 61 Hampshire street, Boston, which will be sent upon request.

R. W. Schmelz, Jacksonville, Fla., claims to manufacture a soldering stick for electrical and other workers which contains no metallic salts or acids, and will not cause short-circuits or other trouble on armatures. Mr. Schmelz also claims that this article is cheaper than salts or acid as well as more convenient.

The Julius Andrae & Sons company of 225 West Water street, Milwaukee, has secured the contract for the switchboard in the new eight-story Germania building in Milwaukee. The board will consist of three marble panels encased in an angle-iron frame. Weston instruments and I-T-E circuit breakers will be used.

It is the custom of the Electric Appliance company to keep its customers posted on any changes in market prices, and to this end it is its custom to publish at frequent intervals a bulletin of prices on staple goods. Such a bulletin has just been issued. It contains valuable information to every purchaser of electrical supplies, and will be sent to the trade on application.

Goldmark & Wallace of 29 Chambers street, New York, manufacture the Hurricane fan motors for direct current incandescent circuits. One type is made for wall attachment, and can be adjusted to throw the breeze downward, to either side or in any intermediate direction. The good points claimed for these fans are numerous and are fully set forth in a recent circular.

For some years the Joseph Dixon Crucible company, Jersey City, N. J., has been supplying graphite resistance devices to telephone companies, electric light companies and electricians generally. The resistances have been so satisfactory and the demand so promising that the company has now added to that department of its works a dynamo and all necessary apparatus for testing purposes, and is prepared to furnish graphite resistances in round or square rods, tubes, spirals, and other forms of one ohm resistance or one million ohms resistance, as required.

The success of the influence machine for X-ray work seems no longer to be in question. The recent development made by the L. E. Knott Apparatus company of Boston marks an epoch of much importance. The designs now made proved so successful that many who had been waiting for more satisfactory results before purchasing at once placed their orders. Many retail houses have already placed large orders, and the manufacturers report that it is with difficulty that they are able to turn out these machines fast enough to supply the demand.

The Metropolitan Electric company of Chicago has taken the agency of the Syracuse rail bond. This bond is said to be the only one on the market that utilizes the fish-plate holes and requires no drilling. It is soldered fast to the rail, and the fish-plate bolts reinforce the joints, making absolutely homogeneous contact during the life of the rail, and giving a surface connection between copper and rail of 10 times the cross section of the bond conductors, thus making the best possible construction. The Metropolitan Electric company has just issued circulars fully describing this rail bond.

General Sales Agent P. C. Ackerman, in charge of the New York office of the American Electrical Works, has been a very busy man of late in making numerous trips to different portions of the country, and the result of his efforts has been seen by large orders. He reports that there is a much better feeling among the purchasing trade than there has been for several months. The product of the Americal Electrical Works is well known. The company's railway feeders and trolley wires, line wire, incandescent and flexible cords and annunciator wires, together with its cables for underground work, are in use all over the country, and are considered standard.

E. B. Latham & Co., dealers in electrical supplies at 136 Liberty street, New York, have issued "Ventilating Catalogue No 3." It is one of the most comprehensive catalogues on the subject of ventilation of recent issue. It would seem that in it anyone in search of something in the fan line can find what he desires. This catalogue gives interesting information in regard to the apparatus. This firm will sell the Tuerk direct and alternating current ceiling fans, having been appointed general eastern agents. They report that the inquiries in regard to fans are far in excess of those of last year, and the indications are that a much larger business will be done in this line than last year.

President B. H. Scranton of the American Electrical Heater company of 197 River street, Detroit, Mich., recently visited Chicago in the interest of his company. The American Electrical Heater company is now energetically pushing its electric heating business and feels that it is in a position to provide heating apparatus that is the very best that money, experience and skilled workmen can produce. The other officers of the company are John Scudder, secretary and treasurer; John Heffron, vice-president, and August Tinnerholm, superintendent. Mr. Tinnerholm is an old electric heating expert, being at one time in the employment of the General Electric company and later with the Westinghouse company. Mr. Scranton talked most encouragingly in regard to the prospects for the coming business as well as the present condition of the electric heating trade.

ILLUSTRATED ELECTRICAL PATENT RECORD.

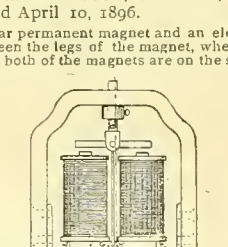
Issued March 9, 1897.

578,345. Thermal Circuit Closer. Hosea F. Maxim, Norfolk, Va. Application filed May 29, 1896.

A thermostat comprising two parallel expansible bars of different strength, and each adapted to be connected with one terminal of an electric circuit, and a relatively stationary contact arranged in the path of one of the bars, and adapted to be connected with one terminal of an electric circuit.

578,380. Call Ringer for Telephones. Joseph A. Williams and Samuel Abbott, Cleveland, Ohio. Application filed April 10, 1896.

A tri-polar permanent magnet and an electro-magnet are fixed between the legs of the magnet, whereby the lines of polarity in both of the magnets are on the same plane.



NO. 578,380.

578,386. Telegraphic Register. Clarence E. Beach, Binghamton, N. Y. Application filed October 21, 1895.

A latch is operated by the magnet and controls the motion of the revoluble part, and a slide or beam is operated by the collision of the revoluble part and latch.

578,394. Manipulating Device for Incandescent Lamps. Joseph J. Dunn and John W. Regan, Boston, Mass. Application filed March 9, 1896.

The device consists of a pair of pivoted expansion jaws pivoted to a case or shell, a flexible shaft or spring attached to the shell, a spring-pressed expander rod arranged within the latter, and links connecting the rod to the jaws, and means provided for closing and adjusting the position of the jaws.

578,402. Car Announcer. William A. Heckard and Dora Ogden, Columbus, Ind. Application filed May 14, 1896.

One claim is for an electro-magnet common to both circuits; means for closing either of the circuits, and thereby energizing the magnet; an open signal circuit, a pivoted lever controlled by the magnet, and adapted when released to close the signal circuit; a lever adapted to cut out the magnet from either of the first mentioned circuits, and also adapted to engage the signal circuit-closing lever, and to thereby maintain an open signal circuit when the magnet is in connection with both of the first mentioned circuits.

578,420. Electric Gas Lighter. Frederick N. Pike, New York, N. Y. Application filed March 11, 1896.

An electric gas igniter consisting of a support for the terminals of an electric circuit, one of the terminals consisting of an arm pivotally mounted on the support and provided with a slot at its pivotal point, and a catch at one end adapted to engage and draw the other terminal to a point close to the point of emergence of the gas where engagement is broken, and means for automatically returning the pivoted arm to its normal position through another path of movement, so that it will not pass through the flame.

578,430. Electric Meter. Elihu Thomson, Lynn, Mass. Application filed August 26, 1889.

A meter is described, consisting of a motor having field magnet coils connected in series with the work-circuit, armature coils connected across the work-circuit and carrying a current which is substantially constant in amount under all conditions of working, a counting, registering or indicating device operated by the movements of the armature, and a retarding device applied to the armature.

578,464. Contact Finger for Electric Controllers. Eugene C. Parham, Johnstown, Pa. Application filed November 18, 1896.

Included in this arrangement are a magnetizable finger member, means for magnetizing the member, and a contact carried by the member and carried between the poles thereof.

578,471. Electrical Cane. Walter N. Sherman, Merced, Cal. Application filed April 2, 1896.

A walking-stick having a chamber therein and a hollow handle, combined with an electric battery, the parts of which are arranged within the chamber, and nested metallic electrodes attached to the handle of the cane and forming a part thereof.

578,520. Telephone Transmitter. Nathaniel Lombard, Boston, Mass. Application filed June 24, 1896.

An apertured supporting ring, an internal circumferential flange thereon, a diaphragm loosely resting upon the flange, a pin centrally of the diaphragm, and a spring having its free end connected with the pin, the tension of the spring serving to normally maintain the diaphragm in a concavo-convex position.

578,539. Trolley Support. Edward Blamey, Jersey City, N. J. Application filed December 4, 1895.

The frame or yoke is connected with a trolley arm by means of a swivel joint or coupling, in which is mounted a supplemental frame or yoke, within which is mounted a spring-supported sliding or depressible frame or yoke, in which is mounted a trolley wheel.

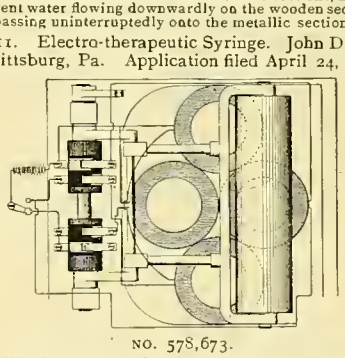
578,542. Trolley Rope Protector. Heman M. Brooks, New Haven, Conn. Application filed August 26, 1896.

The device is provided with a shield or guard to prevent water from running down the cord or rope.

578,595. Electric Lamp Post. James Buckner, Boston, Mass. Application filed June 8, 1896.

The post comprises the tubular metallic base-section, having a tapered socket, the elongated wooden section having a metallic lamp-holder at the upper end and a tapered shank at its lower end formed to enter the socket, the wooden shank being self-adjusting in the socket to compensate for shrinkage of the wood, and a hood affixed to the wooden section above the metallic section, the hood being arranged to prevent the entrance of water into the joint between the wooden and metallic sections, and to prevent water flowing downwardly on the wooden section from passing uninterruptedly onto the metallic section.

578,611. Electro-therapeutic Syringe. John D. Rively, Pittsburg, Pa. Application filed April 24, 1896.



NO. 578,673.

The features mentioned are: A bulb, a flexible pipe leading therefrom, a second flexible pipe, a metallic sleeve between them carrying a binding-post, a casting in the end of the second pipe, a detachable nozzle thereon, a conduit leading therethrough, a socket in the end of the casting, and a wire extending through the second pipe into the socket and electrical connections.

578,670. Telephone. John Weigel, Boston, Mass. Application filed July 14, 1896.

The combination is claimed with an inclosing casing provided with a diaphragm, of a permanent magnet provided with a front pole-piece, a spring interposed between the casing and the magnet and acting on the latter in a direction to move the pole-piece away from the diaphragm, and means to limit the movement of the pole-piece away from the diaphragm.

578,673. Magnetic Apparatus. August Boetcher, Philadelphia, Pa. Application filed May 31, 1895.

The combination in magnetic apparatus of the magnets, one magnet being so arranged in advance of the other magnet that the cores will overlap, a plain cylindrical armature, a frame in which the armature is mounted, circuit closers operated by the armature, whereby the armature will be attracted first by one magnet, and then when above the core of the magnet will be attracted by the other magnet, so as to give the armature a long movement in one direction, with means for returning the armature to its first position

Western Electrician.

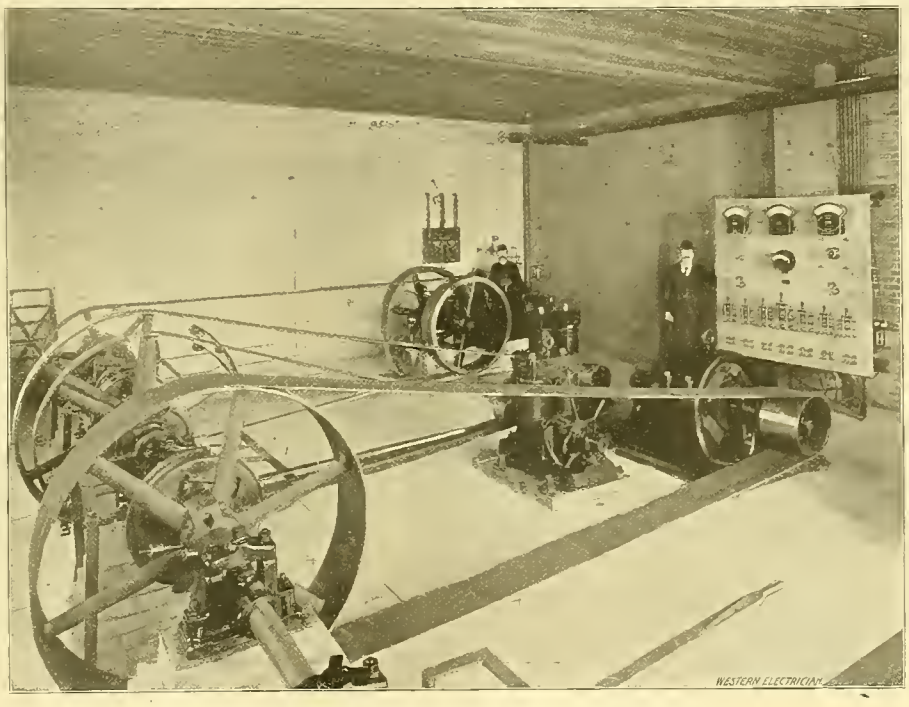
EVERY SATURDAY.

Vol. XX. CHICAGO, MARCH 27, 1897. No. 13

Light and Power at the Milwaukee Hospital for the Insane.

When the remodeled electric light and power plant at the Milwaukee Hospital for the Insane at Wauwatosa, Wis., is entirely completed, matches—at least for the use of the inmates—will be an unknown commodity. What with steam heat, electric lights, electric sad-irons in the laundry, electric curling-iron heaters for the women and electric cigar and pipe lighters for the men, there will be little possibility of the potential danger expressed by the combination of an insane person and a match. It is to avoid this danger especially that the curling-iron heaters and cigar lighters are provided.

The new plant is housed in a detached building having ground dimensions of 100 by 104 feet. There are four tubular boilers, 66 inches in diameter and 16 feet long, made by the Springfield Boiler Works of Springfield, Ill., and equipped with Hawley down-draft furnaces. Two engines and three dynamos comprise the electrical generating plant. Ball engines, rated at 100 and 50 horse power respectively, are belted to each end of a jack-shaft, from which the dynamos are driven, as shown in the illustration. The engines are operated at 250 revolutions per minute. The shafting is provided with five clutches, so that any engine or any dynamo may be connected or disconnected as desired. Two of the dynamos are bipolar Edison machines, of 100 and 150 lights' capacity respectively, which were used in the old plant and thoroughly overhauled before re-installation. The third is a new multipolar Gibbs machine of 45 kilowatts capacity. The engine shown in the picture is the smaller one, and is principally used to drive the smaller Edison dynamo for all-night lighting.



LIGHT AND POWER AT THE MILWAUKEE HOSPITAL FOR THE INSANE.

Tennessee marble is used for the switchboard, and there are two panels, three by six feet, in an angle-iron frame, with ornamental iron work at the bottom between the floor standards. The instruments are of the well-known Weston illuminated dial type, with one voltmeter of the round pattern. Quick-break knife switches, with connections on the back of the board, are mounted directly on the marble. There is also a voltmeter switch. The main line cut-outs are arranged at the bottom of the board.

About one thousand 16 candle power lamps are connected with the wiring system, and quite an extensive use of electric heat and power is also made, particularly in the laundry. Here electric sad-irons are used exclusively, and the change from the old style of heating the irons has been found to be very advantageous. Many of the women employed in this department are epileptics, and as a result of this malady their sensitiveness to heat and cold is blunted. This condition resulted frequently in the unconscious use of irons so hot that the clothes were burned. With the electrically heated irons this danger is avoided, as the winding of the resistance is so calculated that a safe temperature cannot be exceeded. Moreover, no time is lost in walking from the ironing-board to the stove to exchange cooled irons for hot ones.

All of the machinery in the laundry is electrically operated, cumbersome and uneconomical shafting having been to a great extent superseded by individual motors. There is a 15 horse power slow-speed motor in the wash room, a five horse power machine in the ironing room and one of three horse power to operate fans. In the sewing room the sewing machines are driven by a one horse power motor. Power for the general system of ventilation for the main building is obtained from three motors—two of 7½ horse power and one of five horse power—in the attic, which are used to operate exhaust fans. All motors are of the manufacture of the Gibbs Electric company of Milwaukee.

This diversified plant was put in by the Julius Andrae & Sons company of Milwaukee, under the engineering direction of Edgar G. Barratt of Chicago. H. C. Mallory was the superintendent of installation.

Fight for Municipal Ownership in Cicero, Ill.

The question of municipal ownership has been badly mixed up with other matters of a purely political nature in the local election contests in the town of Cicero, which is adjacent to Chicago. The platform of the anti-corporation party contains the following plank:

We believe in the municipal ownership and control of plants for the supplying of water and light and for street transportation, and that early steps should be taken for the ultimate accomplishment of this principle, and in the meantime no existing contract or general franchise should be extended nor any new ones granted for any of said purposes without adequate compensation to the town, and the return to the town of the right to purchase their property at a fair valuation at any time and without first securing a majority vote therefor at a general town election.

It is claimed that the water, light and street railway companies practically own the town of Cicero and that they have not only evaded proper taxation, but that they have furnished very poor service and have exacted very high rates. Competition has recently appeared in the lighting and railway fields and it is hoped that the problem may be solved in this manner without taking the business out of the hands of private companies.

It is reported that the Minneapolis & St. Louis Railway company has let the contract to the General Electric company to equip its Lake Minnetonka and Minneapolis line electrically.

Graded Street Car Fares for Chicago's Suburbanites.

A new factor has been introduced in the already perplexing question of securing transportation facilities for residents of the suburbs of Chicago who have business in the city. The question of graded street car fares from suburban points, according to mileage, has precipitated a brisk contest among the people of Cicero. At a recent meeting of the Cicero town board a proposition made by the Suburban Electric Street Railway company to charge seven cents for a through trip from any part of its territory to the heart of Chicago and around the Union loop, was taken under advisement. Several of the trustees are in favor of holding out for better terms, while others are willing to give the company any concessions it asks, as it has introduced competition into that district. At present the people of Harlem, Oak Park, Austin and contiguous villages are able to ride into the Grand Central depot for a five-cent fare by patronizing the Suburban Electric company, which has leased the Harlem and Batavia branch of the Chicago & Northern Pacific company. By taking the Cicero & Proviso cars and transferring to any of the Yerkes down-town lines they must pay double fare, or 10 cents for a single trip. The Chicago & Northwestern commutation rates are not any better, so that the suburban company has been getting the cream of the business. Patrons have been notified that the five-cent fare could not continue after the lines are equipped electrically and other improvements made, and the company has tried hard to pave the way for a 10-cent fare. It happens, however, that the Suburban company requires large privileges from the Cicero town board in the matter of right of way, and after prolonged discussion with some of the trustees, ex-Judge Shope, attorney for the Suburban company, announced on Saturday that it would agree to a seven-cent fare compromise. It is probable that the amended ordinance will go through in this shape, although there is strong opposition, said to be controlled by the Cicero & Proviso or Yerkes interests.

The plans of the Suburban Electric company contemplate connection with the Metropolitan "L" at Harrison and Forty-eighth streets. The cars will run up an inclined plane, starting at Fiftieth street, until they attain the level of the "L," and will run over that line down-town as trailers, and around the loop. From the "L" terminal the Suburban company's lines will extend in two branches, one running south and west through Clyde, Berwyn and Hawthorne to Riverside and La Grange, and the other running west through Austin, Ridgeland and Oak Park to Maywood. When the Suburban company leased the Chicago & Northern Pacific branch it made a provisional contract with the Metropolitan "L" company, under the terms of which the "L" company was to haul the surface cars to and from the city, from the point at Colorado avenue and Fortieth street, where the two roads intersect. The question of fare had to be settled, however, before this contract could go into effect. The "L" company was not willing to have the uniform five-cent rate to all suburban points

continued, the rate being divided between the two companies. Neither was it considered good policy to charge a uniform 10-cent rate. Graded fares were considered the proper thing, but the two companies could not come to immediate terms. It was finally agreed to let the matter rest until the "L" company had made connection with the down-town loop and had settled up its various contracts with Mr. Yerkes incident to that connection.

Curious Freak of a Voltaic Arc.

Two electric lamps in front of a jeweler's establishment served for lighting the huge watch displayed and

Fig. 1.

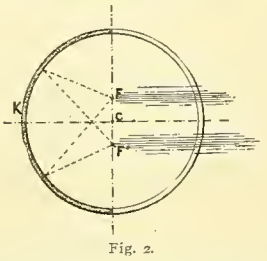


Fig. 2.

CURIOUS FREAK OF A VOLTAIC ARC.

the interior of the store, and were supplied with current by the local lighting company of a small town in France.

The current has an electromotive force of 60 volts, while the primary has a pressure of 2,400 volts. The difference of potential (60 volts) was too high for a single lamp and too feeble for two in series. The remedy applied for this state of affairs was self-induction resistances on the secondary, reducing the difference of potential to 45 volts, and the two lamps were then placed in parallel. Each lamp required 10 amperes of current under normal circumstances.

The upper carbons were of 14 millimeters diameter, the lower ones 10. These carbons were placed in the center of a large globe of transparent glass, which had been silvered on one-half its inner surface, making a hemispherical reflector. The back of this reflector, that is the outside, was covered with an opaque varnish which completely shut off all rays from the arc. These details will enable the reader to appreciate the experience here related.

When the current was first turned on, the lamps performed in a perfectly satisfactory manner, lighting up the sign and the room. Half an hour afterward the lights went out, and remained dark for a short time, when they lighted up again. At the end of about the same time the darkness and re-illumination were repeated.

An examination of the carbons showed that their length diminished out of all proportion to the time they had been burning.

The lamps were extinguished and on examination there were found in the bottom of each of the globes two small spindles of carbon about four centimeters in length, sharpened at one end, and hollowed at the other, as shown in Fig. 1.

The rapid consumption of the carbons was now accounted for, as well as the extinction of the arc, but the cause of all this was for a time inexplicable.

The experiment was then made of modifying the voltage and amperage of the supply, but the little spindles came, and the extinction and the re-illumination went on as before. Closer investigation soon showed the cause of this abnormal consumption of carbon. Fig. 2 will assist in understanding the phenomenon. The carbons in effect occupied the center of a hemispherical reflector, K, and at the moment of lighting the arc was at a point above the center, at F. The reflection, as shown, focused the heat and the light at F^1 on the lower carbon. This concentration left the house and the sign in semi-darkness after a time, and eventually the lower carbon became red-hot, commenced to waste away, and finally burned off at a point. Then the regulator brought the upper carbon down, and the lighting contact was formed. But now the arc being below the center C, the focus was formed as far above as it was before below that point. The upper carbon was heated, wasted and burned off.

The cause having been discovered, a remedy was applied with good results. The spherical reflector was removed and a cylindrical reflector having a parabolic section substituted. Not only was the light made perfectly steady and constant, but the light was concentrated where most needed.

National Electric Light Association.

The Trunk Line association has granted a rate of a fare and one-third, for the round trip, on the certificate plan, from all points in its territory to Niagara Falls, for delegates and members of the National Electric Light association attending the twentieth convention to be held June 8, 9, 10, 1897.

Plans for the Proposed Underground Trolley Road in New York.

The plans for the construction of an extensive system of underground trolley lines in New York city have been in contemplation since the operation of the Lenox avenue electric line was begun in June, 1895, by the Metropolitan Traction company. The experience gained on that road will, it is hoped, enable the company to avoid

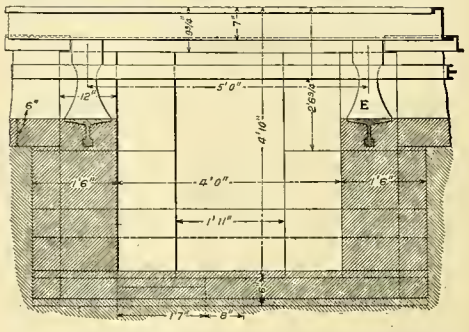


FIG. 2. PLANS FOR THE PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.—SECTION OF MANHOLE THROUGH CENTER OF SLOT.

the most serious draw-backs that have marked earlier attempts with this form of construction. It should be noted in passing that the decision of the Metropolitan company to have the conduit built in the best possible manner has already been demonstrated to have been a very wise determination. It was decided that the very latest practice in cable-road construction should be adopted, undoubtedly with the idea that should the new system prove unreliable the electrical construction could be removed and the cable put in its place. The experiment, although at first pronounced unsuccessful and the system impracticable, is now reported to have proved successful, and the company has completed the preliminary plans for the reconstruction of a part of the Metropolitan system. Many changes have been made since the first experiments were conducted, and it is believed in street railway circles that the Metropolitan company has developed a working system, though nothing is known as to its probable economy.

Features of construction that appeal to the street railway man are described in the *Railroad Gazette*, from which the accompanying illustrations are taken. It will be noticed that a great deal of attention has been given

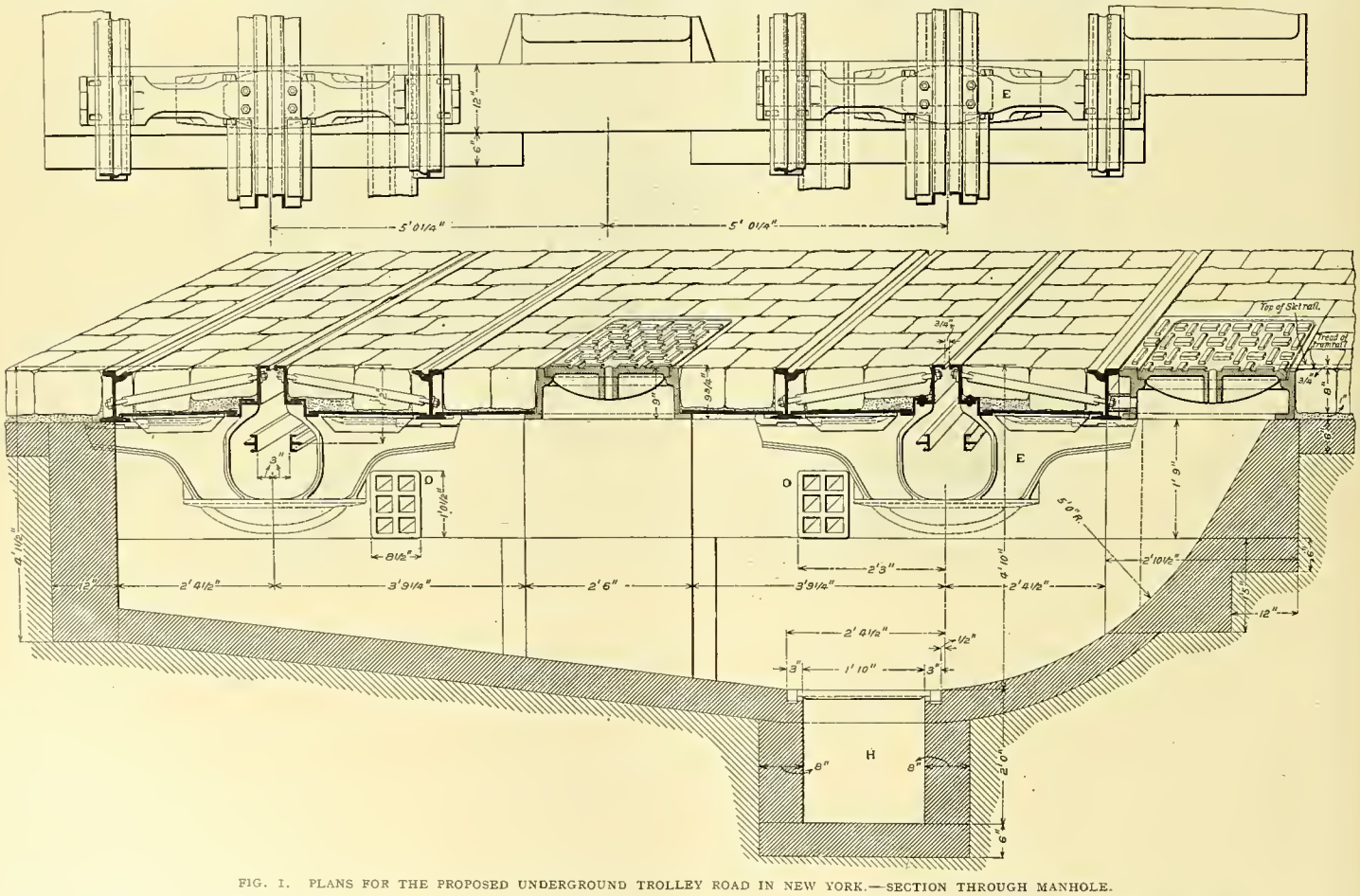


FIG. 1. PLANS FOR THE PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.—SECTION THROUGH MANHOLE.

the construction of the conduct itself; in fact, the principal advancement seems to be shown in road construction and mechanical details. Provision is made for manholes four feet 10 inches in depth, four feet long and 17 feet two inches wide. Fig. 1 shows a section through one of these at right angles to the rails. These are placed 200 feet apart, and are drained by a basin *H*, which connects with the sewers at each opening. This construction is similar to that used on the Lenox avenue line, but the yokes and other metal parts will be of much lighter construction, and the conduit will be wider but not as deep. The ducts *D* carry the feed wires for the electric road, and are connected to the conductor rail from which the car takes power in the same way as the feeder wires are connected with the overhead wire in a trolley road. The city wires are in a separate main near one of the sidewalks. The upper part of Fig. 1 is a half-section view of the yokes, and *E* shows their outlines; the detailed construction is showo in Fig. 4. Fig. 2 is a section through the slot, and shows the manner in which the yokes are secured to the concrete foundation.

Fig. 3 is a sectional view of the insulator. The lower part of the framework as far up as *MN* is one casting. The part of the insulator marked *P* is of porcelain and made so that the castings to which the conductor rails are fastened can be easily put in place. The part *C* is a cement lining to the insulator for the purpose of holding the porcelain firmly in the iron cap *G*. The cement is not relied upon as an insulator, the porcelain answering that purpose. The opening marked *J* is merely a projection on the casting, which is cast thus in order to preserve the proper distance between the iron and porcelain when the porcelain is placed in position in the iron shell before the cement is poured in. Fig. 4 is a sectional view on the line *AB* of Fig. 3.

Fig. 5 shows the shape of the conductors. These weigh 21 pounds to the yard. The track and slot rails are shown in detail in Fig. 6, while the method of holding the latter in place is shown in Fig. 1. The tracks will weigh 107 pounds to the yard and will be nine-inch girder rails 30 feet in length, and it will be interesting to note that this will be the first nine-inch rail to be used in New York. The slot rails will weigh 57 pounds to the yard.

The construction of the underground contact apparatus is simple. The contact pieces shown in Fig. 7 are suspended from the car truck and press against the flat surface of the two iron conductors running the entire length of the conduit and placed three inches on each side of the center-line of the slot. These conductors are suspended from the ceiling of the conduit by insulators, shown in detail in Fig. 3, at a distance of 14 inches below the slot. The return current, instead of following the surface rails, returns by one of the two conductors. The sliding contact, it will be noticed, is supported on spring leaves so that the contact pieces are pressed outwardly against the conductors. These contacts are suspended from a longitudinal bar bolted to cross beams fastened to the truck and constructed of two sheets of steel each laid upon a plate of non-conducting material. The two sheets of the fiber are then brought together, enclosing strips of copper conductors connected at the top to the motor cables and at the bottom riveted to the two pieces of sheet steel mentioned. These run on each side of the plow and serve as supports for the hinges which carry the sliding contact pieces.

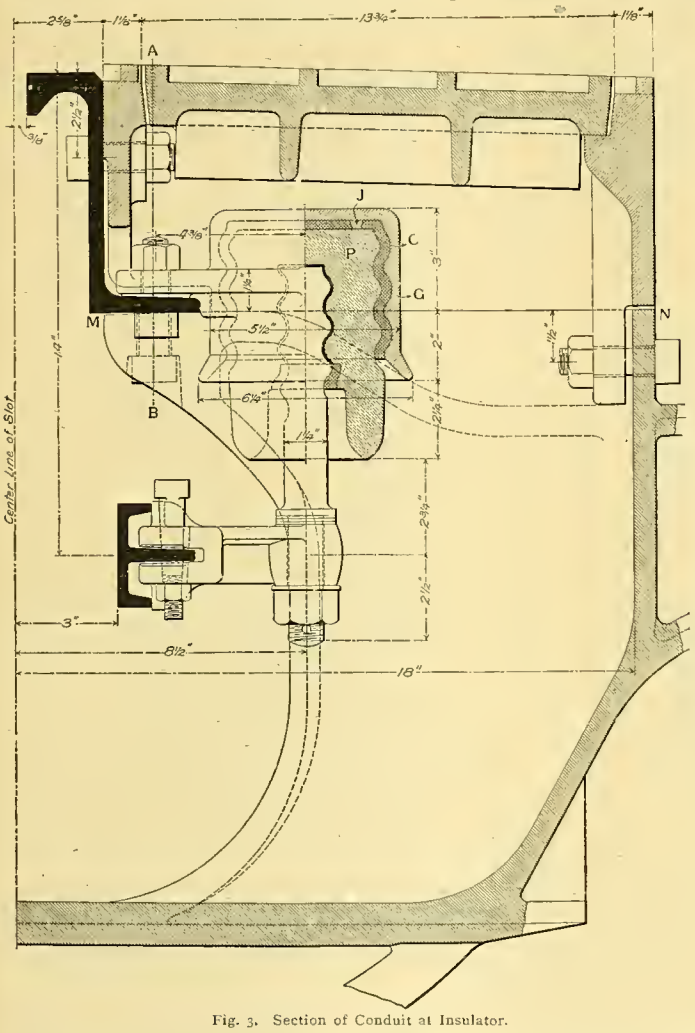


Fig. 3. Section of Conduit at Insulator.

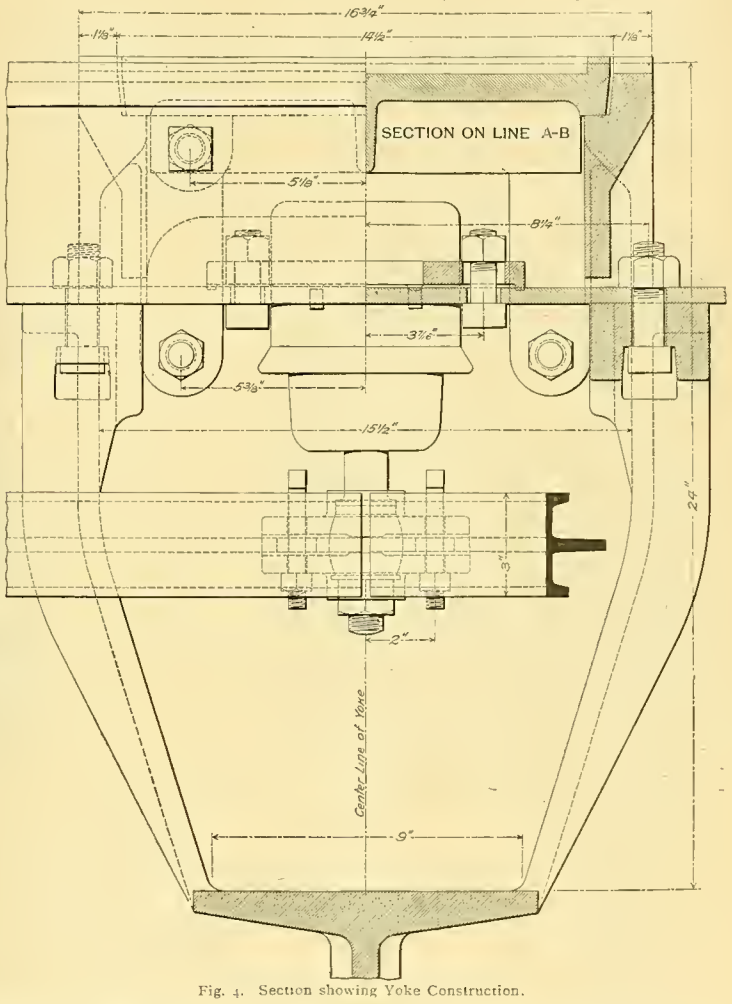


Fig. 4. Section showing Yoke Construction.

PLANS FOR THE PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.

These are of course only the essential features of the plans prepared by the Metropolitan company's engineers.

The officers announce their readiness to go ahead with construction work at once, and the map shown in Fig. 8 indicates the points on the lines of the Metropolitan Traction company where it is proposed to introduce the trolley conduit. The light black lines represent the roads at present in operation. The broken lines with small circles between the dashes show the location of the proposed lines in December, 1894. A few of these have since been constructed. The heavy black dots show the location of transfer stations of the Metropolitan Traction company, and the heavy broken line on Lexox avenue gives the location of the present electric conduit road. As previously stated, the heavy line shows the routes where it is proposed the change will soon be made from horse to electric power. As yet no contracts have been given for the construction, but a large part of the apparatus has been ordered, and the company is ready to begin work as soon as the necessary rights have been granted.

Electrically Annealing Harveyized Armor Plates on a Battleship.[1]

By Charles J. Dougherty.

Considering the rapid development, and the many applications of electricity in the past few years to the various needs and requirements of engineering work, perhaps few people indeed realize the important part which it plays in the construction of the latest type of cruisers and battleships armored with Harveyized steel plates.

As many times before, in other work of different character and equal importance, the subtle fluid was the only agent that solved almost hopeless problems, so also in the case of taking the temper out of certain spots to permit the drilling of holes in the Harveyized plates of some of the recent battleships of the United States, electricity has come to aid on the eve of despair and failure.

The Iowa is one of these ships still under construction at the works of the William Cramp & Sons Ship & Engine Building company, at Philadelphia. She is 360 feet long, with 72 feet 2½ inches beam, and 24 feet draught, having a total normal displacement of 11,296 tons. The main battery consists of four 12-inch and eight eight-inch breech loading rifles in turrets. Her principal vital points are well protected by heavy armor. For a considerable portion of her length, a belt of armor extends from three feet above to 4½ feet below the water line. The upper portion of this armor is 14 inches thick and decreases in thickness from a point a foot below the water line to seven inches at the bottom. The armor, which consists of Harveyized nickel steel plate, is imbedded in the ship's side so that its outer surface is flush with the outside plating of the vessel, while its inner surface is bolted against an elaborate system of framing, forming a portion of the hull.

For those not conversant with the Harvey process it should be briefly stated that it is the introduction of carbon, by cementation, into the face of an ordinary low-carbon steel plate, and subsequently it is water-hardened similarly to an ordinary tool. After this treatment it presents a hard-faced surface to the depth of about one inch, designed to stop and break up projectiles before serious penetration takes place.

The Harveyized plate must necessarily be secured to the structure of the ship by means of large steel bolts, and must be drilled and tapped to accommodate these. At first it was found feasible to drill and tap holes in the face of the plate at any stage of the process prior to hardening, and without detracting from the plate's resistance; but as it was impossible to locate these holes with precision without first fitting the armor into place

1. From *Cassier's Magazine* for March, 1897.

on the ship, this method was abandoned in favor of one by which the carbon was prevented from penetrating over certain areas in the wake of the fastenings. This method also had its disadvantages in that the carbon gases frequently seeped through the protective material and carbonized the surface beneath. The experiments which were made for preventing this carburation could not be relied upon, and the great difficulty was to drill and tap such a face-hardened plate. The oxy-hydrogen flame and the electric arc were applied, but the plate resisted most effectually all attempts to anneal the spots which were required to be drilled. Drills of every design and method of tempering were tried, with no success.

At last the Thomson Electric Welding company of Lynn, Mass., after a series of experiments, demonstrated its ability to anneal any surface, however hardened, by sending a current of large volume through any spot thus to be treated and raising the temperature of that spot to about 1,000 degrees Fahrenheit, and at that temperature there can be no doubt that the temper has been withdrawn. One feature, however, presented itself in the fact that on taking off the heating current, the heat was so rapidly conducted away by the surrounding mass

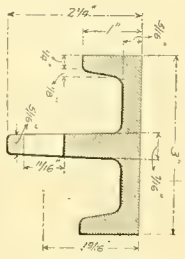


FIG. 5 PLANS FOR PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.—CROSS SECTION OF CONDUCTOR RAIL.

of metal, that it caused the heated spot to become chilled just as if it had been plunged into cold water. No manner of outside protection of the heated spot would prevent this chilling, and it was found that only a gradual and slow withdrawal of the current produced the necessary gradual cooling of the spot.

The apparatus which is necessary to preform the work of annealing these Harveyized plates consists of a separately excited alternating current generator of variable potential, giving a maximum of 300 volts and a current of 100 amperes, the frequency of the generator being 50 cycles per second. The fields of the generator are separately excited by a small direct current exciter of 110 volts, belted direct to the generator from a pulley on the commutator end of the shaft, delivering to the fields a maximum current of 15 amperes at full load. A rheostat, placed close by the transformer—the annealing machine proper—regulates the primary current in the transformer as required by the process.

Two No. 6 B. & S. gauge wires carry the current from the brushes of the generator into the primary coil of the transformer, and two No. 8 B. & S. wires perform the same duty between the rheostat and fields. On the ship, double-pole knife switches, fuse blocks, current and po-

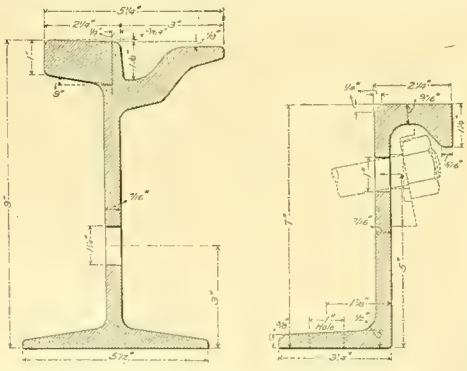


FIG. 6.—PLANS FOR PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.—CROSS-SECTION OF SLOT RAIL AND GIRDER RAIL.

tential indicators are the necessary adjuncts to the working of the plant.

The annealing machine is a transformer similar to the well-known welding transformers used in welding steel rails. It is the copper-clad type of transformer, one in which the secondary is composed of two copper castings, each having a rectangular groove, which two halves, when bolted together, form a closed rectangular frame in which the primary is held enclosed. The hollow space intervening between the primary and secondary is filled with a heavy oil called "transil oil," which acts both as an insulator and conductor of heat from primary to secondary. The secondary, by completely surrounding the primary, affords an excellent mechanical protection and prevents electric as well as magnetic leakage the latter features are quite important, since it is necessary to operate the annealer on board vessels during construction and in exposed positions; yet it may be handled with immunity from electric shocks, even when operated in rain or snow.

The primary coil consists of a copper ribbon, insulated between coils with thin asbestos. The ratio of conversion is 100 to one. The transformer has two trunnions fastened to its sides in a line a little above the center of gravity. These trunnions swing in bearings—part of a yoke which straddles the whole. The yoke, in its turn, has a hook which may be secured at any place of the arch, thus allowing the transformer to be suspended, like a compass in gimbals, in any position desired.

The copper castings which compose the secondary are cut through at one place in the circuit. On either side of the cut two short platforms form the base for the copper contacts of various shapes and sizes, by means of which the currents are made to enter and leave the plate to be annealed. These contacts are made of forged copper, hollowed out to receive water circulation for cooling purposes, and terminate in a narrow tip, rounded out at the end.

The total weight of the annealer is about 1,000 pounds, and this is sufficient to give proper contact pressure for all work on a horizontal plate. When inclined surfaces are to be worked upon, the machine is suspended so that its weight shall not interfere with the contact pressure which is then obtained by bracing the contacts directly, with wooden wedges, against any object near by.

The most remarkable thing in the operation of annealing a spot is the great amount of current that is carried by the copper contacts into the plate. The contact surface itself is seldom more than about half an inch square; yet 10,000 amperes is made to flow through it continually. This is equivalent to 40,000 amperes per square inch—a current capacity which is possible only on account of the thorough cooling of the copper contacts by continuous water circulation through them.

The operation of annealing a plate is performed in the following manner: The transformer is placed in position, the contacts touching the plate on either side of the spot marked to be annealed. Then the primary current is brought up by means of the rheostat to from 75 to 90 amperes for a period of from four to five minutes.

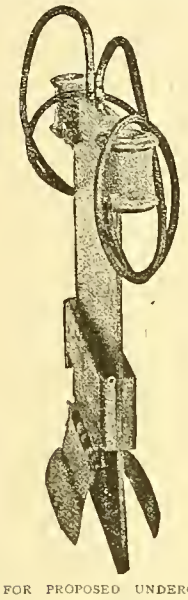


FIG. 7. PLANS FOR PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK—CONTACT DEVICE.

The metal attains a dull red heat, and this temperature is experimentally found by holding a small pine stick in contact with the plate at the spot till it takes fire. This, then, is the maximum temperature desired. The current is then diminished by turning the rheostat one point each minute till all the resistance is placed in circuit, and by this method the spot is gradually cooled, and the chilling of the plate prevented. The operation of running a heat after the machine has been set takes about 15 minutes.

Right under the contacts the metal comes to a bright cherry heat, while the portion surrounding the contacts is just a visible red, and on examining the spot after the annealing process is finished, it is found to be of a dull chocolate color; and the place where the contacts have been resting is scaled and hard and cannot be touched by a tool to a depth of about a quarter of an inch.

In the construction of a modern man-of-war there are many armor plates which act as shields to the guns. Some of these are circular, others oval. The only possible way to perforate these shields was after carburation and before being water-hardened, until the discovery of the electric annealing process above described. But today these plates are cut in various shapes to suit the work, by simply annealing a series of spots forming the shape of the hole to be cut and finally running a cutting tool over the surface thus annealed.

It sometimes happens that the Harveyized plate must have a certain length cut off to suit certain work after delivery at the shipyard, and this occurred in several instances on the Iowa. In place of annealing a line of holes down the plate in the same straight line, side by side—a slow process, indeed, since the machine must be set for each individual hole—a more expeditious method was followed. It will be remembered that earlier in this article especial attention was called to the fact that it was absolutely necessary that the temperature of any individual spot should be gradually and slowly reduced to prevent any chilling. The effect of gradually withdrawing the heat from one spot to another was accomplished by moving the annealer itself relatively to the plate to be treated, the ratio of this movement, of course, depending upon the ratio at which the temperature was to fall in any particular spot to prevent chilling.

The annealer was so arranged as to be moved along a line to be annealed, the motion being obtained by an ordinary screw and nut, held in a bracket, the nut being turned at a predetermined rate controlled by a watch, and it was found that the correct speed was about a quarter of an inch per minute to secure positive and thorough annealing. Thus the work was performed in a short space of time compared to the usual method of setting the machine for individual heats.

The copper contacts were of the simplest kind, as described before, bedding themselves into the surface of the plate, and when dragged along by the screw, raised in front of themselves a chip similar to that produced by a planing tool, and even after a day's continuous running the copper contacts were found to be intact. A number

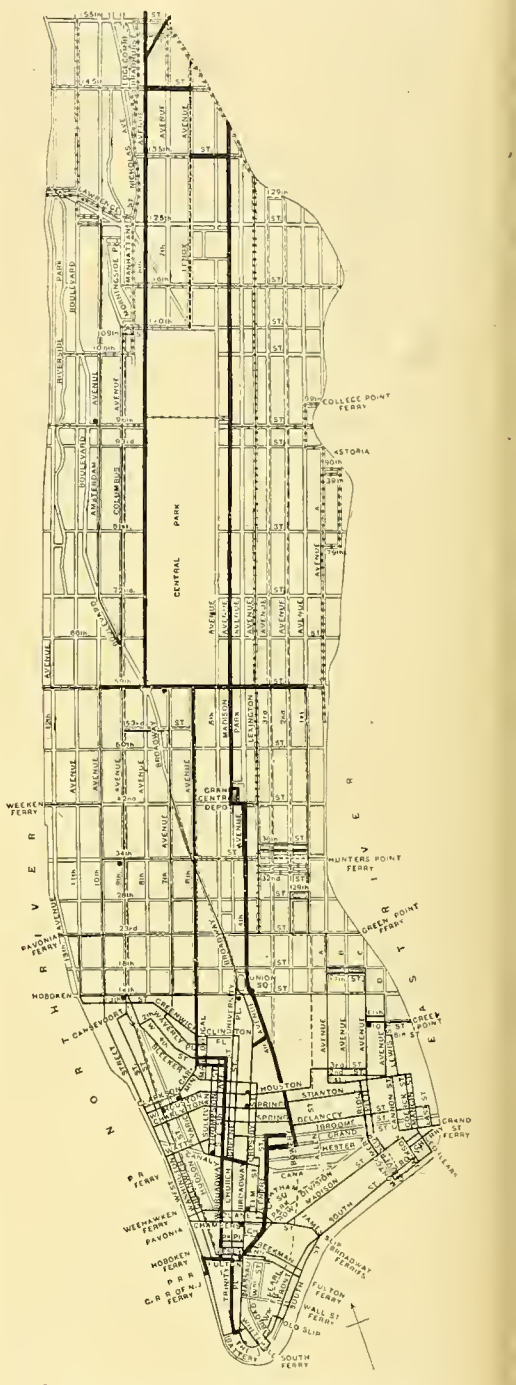


FIG. 8. PLANS FOR PROPOSED UNDERGROUND TROLLEY ROAD IN NEW YORK.—HEAVY BLACK LINES SHOW EXTENSIONS OF LENOX AVENUE SYSTEM.

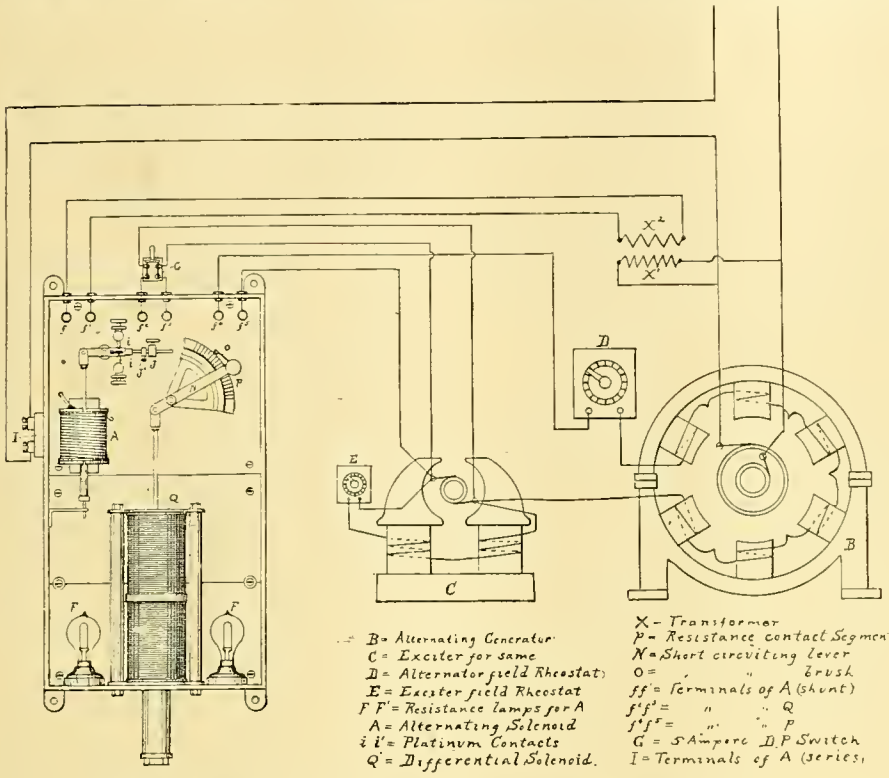
of steel chips were found lying around, thus developing the peculiar phenomenon of a hard steel chip cut by a copper tool.

Besides annealing holes in armor plate, the annealer may be used for the reversal of the annealing process, namely, for creating isolated hard spots in soft tool steel by sending a current through the spot to be hardened until it reaches a bright cherry heat and then suddenly removing the current from the machine.

On the Iowa two complete annealing plants have been at work constantly, night and day, Sundays inclusive, for a period of three months. Six hundred holes have been annealed in the side armor, 800 holes in each of the 12-inch barbettes, and about 500 holes in the diagonal armor, besides many others for scuppers, mooring shackles, eye pads and other fittings, in the belt armor.

Chapman Voltage Regulators.

No electrical man needs to be told the importance of closely regulating the voltage in the operation of incandescent lamps, and anyone who presents a plan offering improvement in this direction is certainly entitled to a respectful hearing. This is the case of the Belkoap Motor company of Portland, Me., which asks attention for the Chapman voltage regulators for both direct and alternating current. The company considers this invention, which is patented, an important one, and offers reliable consumers the privilege of 30 days' free trial. Herewith are presented diagrams of connections for both direct and alternating current systems.



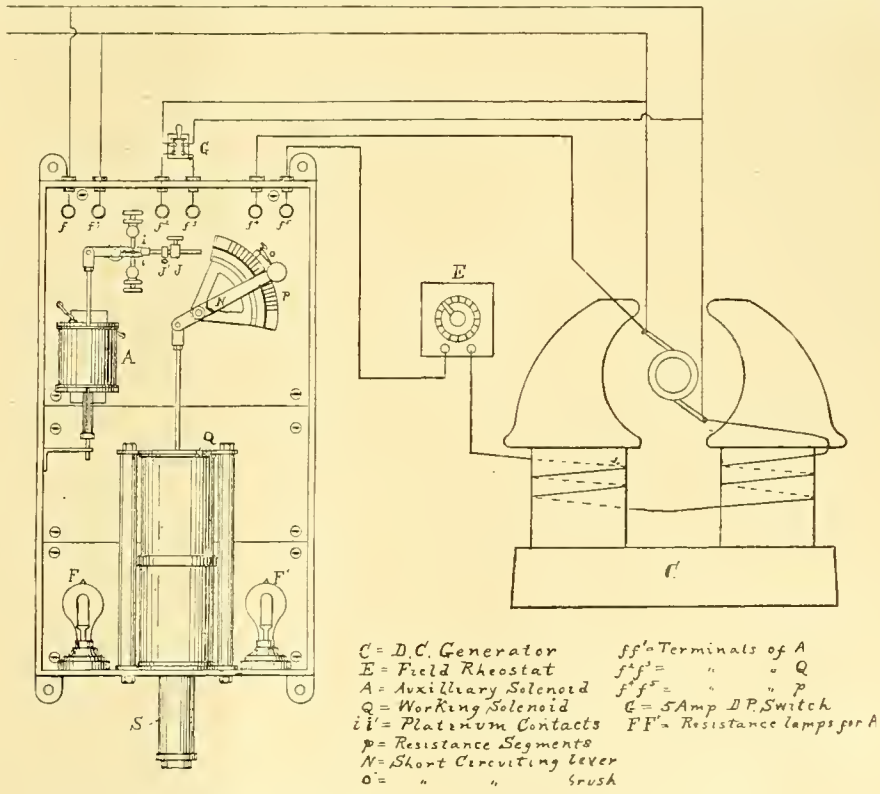
CHAPMAN VOLTAGE REGULATOR—DIAGRAM OF CONNECTIONS FOR ALTERNATING CURRENT.

The regulator is a magnetic device and acts very promptly, being only limited in quickness of action by the ability of the generator it may be regulating to respond to change on a field rheostat. The device is essentially a field rheostat whose operation is entirely automatic. The moving of the rheostat arm is accomplished by the action of a working solenoid, and the actions of the working solenoid are determined by those of an auxiliary solenoid which operates a set of contacts that control the admission of current to the sections of the working solenoid. The working solenoid is differentially wound and is composed of four distinct coils, two of which have a small continuous current flowing through them, in mechanical opposition to each other; the contacts close the circuit of one or the other of remaining coils and so neutralize the action of one of the continuously acting coils.

This manner of connecting secures a rise of magnetism in the iron core of the solenoid whenever a break occurs at the contacts and so avoids any injurious sparking at the contacts that would naturally occur by the magnetic discharge of the core. The arrangement completely neutralizes the induction discharge, and no induction spark can occur. All of the usual objection to contact points is therefore removed, and they may be set very close and secure the most sensitive adjustment of the apparatus.

The entire work of the auxiliary solenoid is to move a lever arm with contact attached through a short space of say one-thirty-second inch, and a very slight change of voltage is sufficient to do this. It is often desirable to have the voltage at the generating station rise a little with the load so that it becomes greater than the voltage at the distributing center, where it remains constant with changes of load. This result is aimed at in the compound winding of the generators, but, in many cases, it is impossible to secure the result desired on account of the changes of speed, which no compounding of the generator can compensate for. The compounding of the auxiliary solenoid, however, secures the desired result under all conditions of speed or load, and a plain shunt-wound generator becomes just as effective as a compound-wound generator. The use of this regulator is said to enable the old style alternating current generators having no compound coils to do just as good work as the more modern apparatus. Many machines that have been discarded as out of date may again become valuable and equal to the best. And this is also true of direct current generators There are many old generators of the shunt wound type that may become just as useful as the more modern built machines and even more so by the attachment of the voltage regulator to them.

As to the energy consumed in the Chapman regulator, it is said to be so small as to be negligible. The operation of the large working solenoid only requires the use of 60 or 70 watts of energy, and the rheostatic part of the device is concerned only with the current in the shunt winding of the generator which, as is well known, is only a very small percentage of the output of the machine. So that the regulator may be operated on a machine of 150 kilowatts with an extra expenditure of energy not exceeding one-fourth horse power. The Chapman voltage regulator for varying speed dynamos is claimed to solve a question of great importance to users of electric light. Central station people know the importance of unvarying voltage. It is simply out of the question to think of satisfying the general public without an almost absolutely steady light, and there is no way of doing this except by means of some kind of a regulator outside of the generator itself.



CHAPMAN VOLTAGE REGULATOR—DIAGRAM OF CONNECTIONS FOR DIRECT CURRENT.

Improved High Frequency Coil.

To one who has investigated the methods of exciting X-ray tubes the early difficulties encountered in making an efficient tube seems not so surprising, The only instrument then available for excitation was the induction coil, and it was then, as it is now, an extremely delicate undertaking to secure and maintain the right degree of vacuum.

Both manufacturers and manipulators of the induction coil agree that the correct exhaustion is the all-important consideration. This difficulty being apparently insurmountable, the laboratory department of the L. E. Knott Apparatus company determined to continue its investigations in order to still further perfect the high-frequency coil. It was early shown that with this instrument the question of vacuum was not of such great importance as had been supposed, the rapidity of discharge being sufficient to produce good X-ray power with any reasonable degree of exhaustion.

During these investigations a new and simple method of discharging the condenser with rapidity and uniformity was developed. The early coils of Hertz, Tesla and others employed numerous devices for producing this effect, all of which were complicated and decidedly unsatisfactory when applied to X-ray work, where regularity was of the utmost importance. With these devices the "tuning" or changing the capacity of the condenser to meet the varying conditions of the current was a difficult undertaking. Fortunately, this new device rendered that entirely unnecessary, as it was proven that the rapidity and power of discharge could be easily regulated by simply closing or opening the spark gap. It is believed that it is this device which has made the high frequency coil the most successful X-ray generator and the most practical instrument for hospital and surgical use.

Since this coil may be operated by an alternating current it has been supposed by some that sharp definition was not to be obtained. The results obtained by many well-known experimenters, among whom may be mentioned A. B. Shallenberger of Rochester, Pa., and Dr. F. F. Strong of Boston, prove beyond question that this belief is erroneous.

Looked at from the point of view of penetrating power, clear definition, ease and convenience of operating, the high-frequency coil commends itself to all practical workers.

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FOR a time, at least, the electrical fraternity of Detroit will be rid of Pingree, and, although he threatens to return, it in common with the rest of the community will be afforded a breathing spell and will be thankful for the favor. Relief from the eccentric reformer came very unexpectedly. The Hon. Potato Patch thought he was big enough to fill two important offices in the public service and accordingly when he was elected governor of the state he refused to give up the office of mayor. This was not entirely satisfactory to the taxpayers and they proceeded to force him to abandon one of the offices. There was some difference of opinion as to which position he should give up. The people of Detroit wanted to get rid of him and they tried to saddle him on the state at large, but this was not relished by the commonwealth. It did not take the people of Michigan long to find out the kind of man they had chosen and they were sick of their bargain. Finally, it was agreed to refer the matter to the Supreme Court of the state. That tribunal promptly pronounced the office of mayor of Detroit vacant, greatly to the chagrin of the governor. The ex-Pooh Bah announced that he would resign from the governorship and enter the race for the mayoralty, but he thought better of it later and decided to retain the position he had in his grasp rather than take the chance of being defeated.

MASS meetings have been held in Chicago denouncing the Humphrey bills and political candidates have been given an opportunity to place themselves upon record upon the general proposition of the regulation of street railway properties. The street railway companies are exerting themselves to secure the passage of the bill. President Wheeler of the Chicago City Railway company has published a statement showing the growth of the system on the South Side, and illustrating in a forcible manner the improvements that have been made in transportation facilities in that part of the city. He demonstrates the fact that residents of this city can now ride 15 miles for five cents, whereas in 1859 they could ride little more than one mile. Other advantages have been increased in corresponding proportion, until now many persons during the warm season ride in the cars for pleasure.

FAVORABLE reports are received from the management of the Trans-Mississippi and International Exposition to be held in Omaha from June 1st to November 1st, next year. One of the principal buildings will be given up to electrical display, and a special feature will be the lighting of the grounds and buildings by electricity. The department of exhibits announces that gold and silver cups and gold medals will be awarded the best displays in several departments, one of which is electricity. The interest thus far shown in the plans of the exhibition company encourages the management to anticipate a comprehensive display in every department. It is the aim of the exposition authorities to make the exhibition an illustration of the advancement made in the several departments represented, thus marking the industrial progress of the country.

IT would seem as if the explosions in electrical subways would call attention to the necessity of providing means for properly ventilating these conduits. We have already mentioned a casualty in Boston of this kind, and now another serious explosion in a New York subway is reported. In both places electricity has been blamed for the ignition of gas in the subways, and it seems to be quite probable that this was the cause of the explosions. The only effective method of preventing similar accidents wherever electric wires are buried is that of providing a ventilating system that will keep the subways and manholes free from gas. Such an arrangement will entail only a slight additional expense and should be insisted upon by the city officials wherever the gas and electric companies do not display the proper spirit in meeting the emergency.

PARIS and New York are greatly agitated over the threatened invasion of the sacred precincts of the Champs-Elysees and Fifth avenue by the electric railway. In the French capital it has been made an issue between the masses and classes. The advocates of the electric railway contend that it is a struggle between the blouse and the frock coat. They point out that the means of communication from one part of the city to a distant point are inadequate for the poor people and that there is a real need of the proposed railway. On the other hand it is declared that aside from æsthetic considerations there is the objection to having the traffic on this drive seriously interfered with. It is also claimed that such a railway would endanger the lives of the children of the neighborhood who play thereabouts. But it is evident that the opposition is based almost entirely upon the objection to the presence of a railway upon the great pleasure drive in which Parisians feel a natural pride.

The same considerations are found in the controversy over Fifth avenue, New York. The announcement that the boulevard line of surface cars, which is controlled by the Third avenue company, would hereafter transfer passengers to the Fifth avenue stage line was taken as indication of the intention of the street railway company to get possession of the stage line franchises and use it as an entering wedge to obtain consent for a transformation of the present system into an electric road. This is acknowledged by the New York *Herald*, which says in its comments upon the controversy in the French capital: "So the Parisians are getting a little taste of our own difficulties in keeping tramways off of Fifth avenue. We have thus far succeeded in keeping that one driveway free from the infliction of tracks and cars, and if the Parisians stick to their Elysian Fields as stoutly as we have to our fashionable parade ground, they should win their fight." The principal obstacle to a railway line in Fifth avenue is the provision of the bill authorizing the repavement of that thoroughfare in 1885 which reads as follows: "Except for the necessary crossways of railroads laid in Fifth avenue at the intersection of other streets, no railroad shall be laid upon, above or along any part of Fifth avenue, in the city of New York." It is admitted that this act must be amended before a railway line can be established in Fifth avenue.

CONSIDERABLE activity is promised in electrical circles in Chicago during the coming season. The Alley L road will be transformed into an electrical system and the change will necessitate the employment of large numbers of skilled electrical workers, as well as the purchase of considerable apparatus for station equipment and line construction. A large sum of money will consequently be expended in this single undertaking. Another large enterprise is the building of the Cosmopolitan Electric company's system. A power house, equipped with apparatus for arc and incandescent lighting and power service, will be built this summer and a complete system of underground mains completed. A good deal of the work in the conduits has already been done, and the work will be prosecuted in the business district at once. Other projects not so pretentious, but of considerable magnitude, are under way. All of these will contribute to the general welfare and help revive and stimulate the industry.

IT is not infrequently seen that men seeking reforms and improvements in public service resort to methods that are not only questionable but are positively dishonest. They seem to think that because in their opinion the measure they advocate may eventually result advantageously to the people they are warranted in securing its adoption by the most objectionable means. Intelligent public opinion will not approve this view of the case, especially as there is always danger of such proceeding being taken as precedent. When, therefore, it is proposed to relieve a portion of the city of Chicago from the oppression of a street railway monopoly by securing a franchise for a competing company through fraudulent means, the outrage naturally provokes the resentment of every right-minded man. It is not enough to be enlisted in a good cause; it is absolutely necessary to employ only legitimate methods. Then appeal may be made to the community in support of a legitimate enterprise, and the promoters may go before the people with clean hands. The attorney-general of Illinois has placed himself upon record as being opposed to all measures secured through objectionable methods. He declares that a street railway company has no right to enter upon the occupancy of public streets without first having obtained a license from the City Council, and that the City Council has clearly no right to grant such license except upon petition therefor by the owners of the land representing more than one-half of the frontage of the street or so much thereof as is sought to be used for railroad purposes. An ordinance passed without such petition is void, he declares, and confers no right upon the railway company. He says: "I can see no difference in this respect between an ordinance passed without any pretense of such petition and one passed on forged petitions or purchased consents, which the Supreme Court of this state has held to be illegal. I know it is strenuously contended in this case that the requisite petitions were before the Common Council at the time this ordinance was passed, but I think that is, to say the least of it, an open question and one which, upon the evidence contained in this record, ought to be submitted to a court for its determination." It is true the attorney-general ought not to permit his office to be used by private persons or corporations and to subserve purely private interests, but where there is a question of public interest and public rights are jeopardized which it is the duty of the attorney-general to protect, he cannot refuse to perform his duty because while protecting the public interests he at the same time and unavoidably confers a benefit upon private persons and corporations. Charges of bribery from reliable sources ought to be sufficient cause to warrant official investigation.

Barrett Advised to Ponder on the Situation.

Barrett's ill-advised attacks upon Professor Stine and Mr. Merrill are resented very properly by the insurance interests. The *Argus* of Chicago, the leading insurance journal of the West, has the following comment in the issue of March 16th:

We passed by at the time the unseemly and foolish attack by City Electrician Barrett upon William H. Merrill, Jr., the electrician of the Electrical Bureau of the National Board, and Professor Stine of the Armour Institute, because, as referees to examine and report upon two systems of fire-alarm boxes in this city, they gave an unbiased decision instead of simply praising Barrett's pet system. We did not refer to the matter in these columns, because we assumed that Barrett's friends would advise him that the less said about the matter on his part the better. We seem to have been mistaken, as the following from the *Chicago Record* of March 9th shows:

"A technical journal of this city, which draws its inspiration from City Electrician John P. Barrett, is now engaged in blackguarding Prof. Stine of Armour Institute and W. H. Merrill, both experts in electrical science, because of the report made by them recently regarding certain fire-alarm boxes. In this report serious defects were pointed out in Prof. Barrett's favorite box, which he causes the city to purchase exclusively, at a price which should be the subject of quite as close investigation as the quality of the box itself. It is clear that Prof. Barrett's mouthpiece finds scurrilous epithets more convenient weapons than facts when engaged in an effort to break the force of the telling stroke which those two gentlemen gave to the peculiar business methods of John P. Barrett."

The *Record* also says some other things which Mr. Barrett may do well to ponder, both personally and as a public official.

Plans of the Cosmopolitan Electric Company of Chicago.

The Cosmopolitan Electric company of Chicago is now ready to invade the down-town business district, and it proposes to extend its mains at once from the river to the lake front, branching out north and south, so as to include in the territory which it will supply the retail district and the big office buildings. Arrangements have been made to put a large force of men at work so that the streets will not be torn up any longer than is absolutely necessary.

The plans of the company provide for the extension of the underground mains from the river through Jackson street to Michigan avenue. It will occupy Wabash avenue, State and Clark streets, between Jackson and Washington streets, and in the latter thoroughfare a conduit will be built from Michigan avenue west to connect with the network of conduits already laid on the West Side. The extent of the work already done by this company is not generally realized, as very little has been said about it. Last fall it put in 24 miles of conduit on the West Side. Up to the present time it has done no construction work east of the river, but this section will be covered at once. The streets occupied by the company on the West Side include the best residence section of that division and also the manufacturing district. Plans for furnishing arc and incandescent lights and motor service are under consideration, but the details of the system have not as yet been approved. The company proposes to build its power house this summer and promises to be ready to supply current in the fall. It has already received many assurances of support and co-operation from property owners and residents of the West Side who are desirous of securing electric lights. The company discourages the idea of a warfare upon existing corporations. It believes there is room for a new company and will proceed upon that theory.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The American Telephone & Telegraph company has been granted a right of way through Iowa City, Ia.

A bill has been introduced in the Minnesota Legislature making the maximum rates for a single-wire telephone instrument at $4 and a party line at $3 for business houses, and a dwelling $2 50 where the instrument is located within a mile and a half of the exchange, with an additional charge of 25 cents for each half mile additional.

A. A. Balluff succeeds A. F. Cutter as secretary of the Iowa Telephone company.

The Iowa Telephone company has established an exchange at Cascade, Ia., with 19 subscribers.

A telephone line is projected from Marshfield, Wis., to Medford.

Milnor and Forman, N. D., chess clubs are playing chess by telephone. The service is good and crowds witness the games.

A telephone exchange is urged for Clarksville, Iowa.

The Spokane & Columbia Telepone & Telegraph company of Spokane, Wash., expects to have telephone connection with Rossland, Traill and other towns in the new gold regions in Boundary creek region. An exchange in Spokane is proposed also.

Electrical Equipment of the Alley "L," Chicago.

Chicago's first elevated railroad was the one built on the South Side some six years ago and which is popularly known as the Alley "L," from the fact that for a distance of nearly four miles it runs through an alley between State street and Wabash avenue. The road is 8½ miles long and has a substantial overhead structure built for double tracks for about seven miles and for three tracks for the remainder of the line. The trains are hauled by steam locomotives using anthracite coal. During the World's Fair year the Alley "L," which landed its passengers inside the enclosure at Jackson Park, did a very large business, but since then it has never been able to pay running expenses and meet the fixed charges. Things went from bad to worse, until a reorganization was effected by the bondholders a few months ago. The company is now the South Side Elevated Railroad company, with Leslie Carter as president, and an effort is making to put it on a paying basis. Two great improvements are to be made in the service to this end during the present year. One is the connection with the down-town Union elevated loop, described in the WESTERN ELECTRICIAN of January 16th last, by which badly needed terminal facilities in the center of the city will be secured. The other change is the electrical equipment of the road, by which the operating expenses will be greatly reduced. It has long been recognized that economy demanded the abandonment of the steam locomotives, with their expensive help and fuel, but it is only since the bondholders' reorganization that the matter was taken up in earnest. At first some attention was paid to compressed air, but the directors soon concluded that, in the present stage of development, it would not be wise to depend upon pneumatic power. This left the field clear for electricity, and the question arose whether it would be more advisable for the company to generate its own current or to buy it. Estimates were secured and carefully considered, and the directors have now come to the final decision to use electrically transmitted power from their own power house. Work to effect the transformation from steam to electricity is even now under way under the direction of Sargent & Lundy, the engineers who have been retained to design and supervise the new plant, and October 1st next is set as the time for the electrical trains to be in operation. The specifications for engines, boilers and generators will be issued at once.

The power plant will be erected at Fortieth and State streets, which is about midway between the terminals of the road. The building will be of the usual power house construction of iron and brick, one story high, and extend about 120 by 100 feet on the ground. An iron stack, tile-lined, about 180 feet high, is contemplated. A plant having a capacity of 5,000 horse power will be put in at first, with provision for extension if the growth of the traffic makes it necessary. Water-tube boilers and probably some type of automatic stoker will be used. The engine-dynamos will consist of four units of about 850 kilowatts capacity each. Cross-compound condensing engines will be directly coupled to multipolar generators built for a potential output of 650 volts. The use of this high voltage will be one of the distinguishing features of the plant. The present alternating current lighting plant, used for the illumination of stations and platforms, will be abandoned, and the buildings and cars will be lighted from the power circuits, with six incandescent lamps in series.

In the line equipment the most interesting feature is the fact that the road will be divided into 18 sections, each about half a mile in length, each section to be supplied with current by a separate and distinct feeder from the power house. This is a departure from the usual method of feeding current on elevated electric railroads, as the tree system of distribution has been employed heretofore. By the use of section feeders it is not likely that a short-circuit or other breakdown will disable more than one section; the trouble can be readily located and remedied with comparative ease. The whole system is flexible, and it is claimed that the increase in copper will not be excessive. The feeders, which will be bare copper cable, are planned for a drop of not to exceed 25 volts at any section, so that the motors will be operated at 625 volts. The third-rail system of contact will be used, and in general the construction on the Union Loop, as recently described in the WESTERN ELECTRICIAN, will be followed. However, the contact rail will be somewhat lighter, and a new type of insulator will be employed. The track rails will be bonded and electrically connected to the structure at intervals.

Forty-five car-bodies of existing passenger coaches will be remodeled to be mounted on new trucks as motor cars. As on the West Side elevated roads, there will be compartments at either end for the motorman, and the remainder of the car will be used as a smoker. The motor cars will be equipped with about 250 horse power in motors—perhaps one motor of 125 horse power on each truck. Three and four-car trains will be operated; and the speed and train schedule will naturally depend on the new conditions met with in operation around the loop. At any rate, the motors will be up to any speed requirement that may be made upon them. The motor and trail cars will be electrically lighted, of course, and probably heated by electricity also.

The decision of the South Side Elevated Railroad company means a number of important contracts for manufacturers in the electrical and allied interests coming at a time when orders are not too frequent. Not a few engine, dynamo, boiler, truck, wire, motor and other salesmen will find it convenient to drop into Sargent & Lundy's office for a little chat within the next few months.

Fire in a Chicago Edison Station.

Fire was discovered in the South Side station of the Chicago Edison company last Saturday, and before it could be reached considerable damage had been done. The power house which was the scene of the fire is located on Wabash avenue near Twenty-sixth street, and supplies current for the district between Sixteenth and Thirty-ninth streets. This is largely a residence district, and the company's business in the locality is principally residences and small stores. Fortunately the temporary shut-down made necessary by the fire did not greatly inconvenience the patrons of the company, and the load was transferred to the Harrison street station. The fire started in the basement of the building, where a pile of waste had been accumulated. The station was filled with smoke so that the firemen had considerable trouble in reaching the fire. The damage is said to be comparatively light.

Litigation Over Car Heating Apparatus.

The Consolidated Car Heating company of Albany complains that the statements of the American Electric Heating company of Boston, upon the scope and effect of Judge Coxe's decision, as presented in this journal on February 27th, were inaccurate. The Consolidated company says: "The fact of the matter is that the decision affects nothing but the use of an indicator on switches, and it has nothing to do with the electric heating system, or with the switch itself, or the combinations, but merely the indicator, and if the indicator is changed infringement is avoided." The company announces that it will appeal the case.

Talk that Was Not Cheap.

[From the *Rochester Democrat and Chronicle.*]

A Rochester manufacturer dropped into a long-distance telephone office yesterday afternoon and told the young woman in charge that he wished to talk to New York. Thereupon he was promptly connected and at once proceeded to talk. He talked quite a little while. Then he had an afterthought and talked again. Then the man in New York thought of something and the Rochester man talked some more. Outside the booth two men were pacing the floor, one of whom wished to have his canal boats lying in the slips at Buffalo painted and the other was anxious to reach the head of the great salt industry of Syracuse. They paced with more or less patience while the Rochester man talked. At last the door opened and the talker emerged.

"How much do I owe?" he asked of the girl in charge.

"Are you aware," she said, "that you have been in the booth for some time?"

"Oh, yes," he said. I suppose your regular charge for New York is three dollars and a half?"

"Yes," she said in a business-like, way "three dollars and fifty cents for five minutes. Your bill is twenty-five dollars and ninety cents."

New Emerson Alternating Current Fans.

The Emerson Electric Manufacturing company of St. Louis is prepared for the season of 1897 with a complete line of alternating current fans, having eight distinct types—two each of 12 and 16 inch desk fans for 16,000 alternations, one each of the same sizes for 7,200 alternations, and two of ceiling fans. The cuts show typical desk and ceiling outfits, with some details of construction.

Fig. 1 represents a 45 watt motor designed for 7,200 alternations and connected to a 12 inch desk fan. The regulating switch is at the back, and there are four stops for the contact lever. One contact opens the circuit, and the others are designed to operate the motor at varying degrees of economy and speed. The tip of the switch handle is shown at *I* in Fig. 2. This cut (Fig. 2) shows the motor case partially broken away to disclose the double bearings and oiling arrangement. *F* is the oil well, showing felt packing; *G* is the oil hole and *H* the double bronze bearings. There is ample space between the bearings for the lubricant, and this is filled with graphite. The armature, in common with all motors of the induction type, has no insulation and cannot burn out. The motor is claimed to be exceptionally efficient and economical in current consumption.

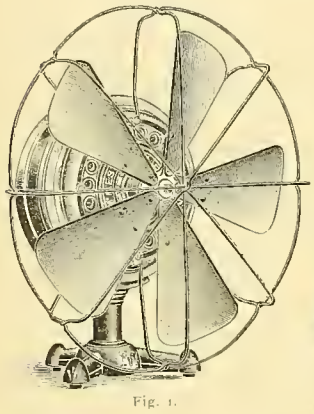


Fig. 1.

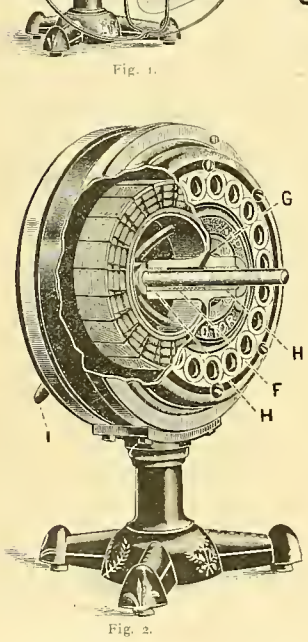


Fig. 2.

The general appearance of the new Emerson ceiling fan with induction motor is shown by Fig. 3. The outside design is graceful and artistic. A direct-acting slow-speed motor of the induction type supplies the power to operate the blades. The interior construction is shown in Fig. 4, parts being indicated as follows: *A*, hook eye; *B*, set screws to faster sliding extension; *C*, pipe connector; *D*, set screw to fasten hanger; *E*, wires from line to binding posts; *F*, wires from binding posts to switch; *G*, steel shaft; *H*, armature; *I*, oil reservoir; *J*, lead washer; *K*, height of oil in reservoir; *L*, upper hardened steel bearing; *M*, steel balls; *N*, lower hardened steel bearing; *O*, switch. In general construction the motor is merely a "wheel within a wheel," the outside wheel (the field) being stationary, while the inside wheel (the armature) revolves on a large solid shaft on a ball bearing, immersed in a cup of oil. There is no moving wire, no commutator, no brushes, no reduction gear of any kind, no friction wheels and no wearing parts whatever, except one large solid bearing, and this revolves at only 150 to 210 revolutions per minute. There is only one bearing to oil and only one place to oil it, and it is said that by filling the oil-cup to *K* (Fig. 4) the supply will last an entire season. In simplicity, appearance and workmanship this is claimed to be the ideal ceiling fan.

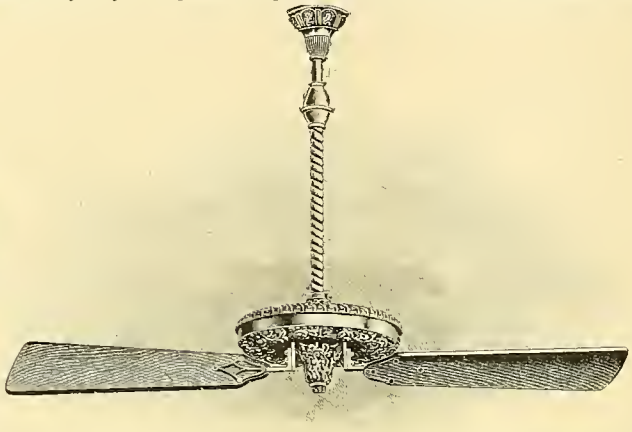


Fig. 3.

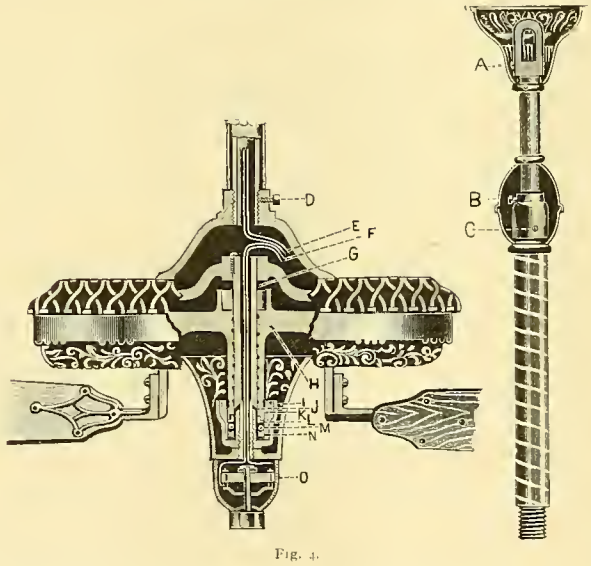


Fig. 4.

NEW EMERSON ALTERNATING CURRENT FANS.

Snap Switches.

The rapid increase during the last few years in the number of incandescent lights in use has created a growing demand for appliances for controlling them and facilitating their use. One of the most familiar of these appliances is the snap switch for placing the means of control of the lamps on an electrolier or elsewhere within easy reach of the hand. Not many years ago almost any sort of a thing that would, with more or less manipulation, light and extinguish the lamps filled the bill, regardless of its mechanical construction or its appearance upon the wall. Of late years, however, the demand has been for a more ornamental as well as a more durable and reliable article. Consequently, snap switches have been greatly improved in their construction. This, however, does not apply to that class of switches whose only merit is their low price, and which are not in competition with the higher grade of switches.

The selection of a snap switch for use on a certain piece of work is frequently not given the attention that it deserves, and it is regarded as one of the minor and unimportant details of construction; whereas it is really a matter of importance, to be settled by the selection of that switch which comes the nearest to fulfilling all the requirements of safety, durability and convenience.

The chief requisites for a snap-switch are quick and positive action when the actuating member has been turned or moved a predetermined distance and the locking of the automatically moving parts against accidental displacement after such action has taken place. Equally important are the contacts, or that portion of the switch to which the terminals of the circuit are attached, and which serve to carry the current, by means of the switch-plate, to corresponding contacts to which the terminals of the lamp circuit are attached. The contacts should have large contact area relatively to the amount of current to be carried, and should have a strong pressure upon the switch-plate or driven member of the switch. The large area is necessary to prevent "cutting" between the switch-plate and contact surfaces, due to long use and neglect combined. The pressure is necessary in order to insure the permanency of the rated carrying capacity of the switch. If a light pressure is used, no cutting will probably occur; the switch will move freely if the mechanism is reasonably good, and for a time it will carry its rated capacity of current without heating. In a comparatively short time, however, the surfaces depended upon to make contact will tarnish and collect dust, and their conductivity will be impaired to such an extent that the switch will heat and become worthless. Aside from the fact that the carrying capacity of a given area is regulated by the pressure, the pressure is also necessary in order that there may be sufficient friction to keep the contact surfaces in a proper condition to carry the current safely. Another cause of trouble is this, that if a switch-plate or its equivalent makes contact by a movement the reverse of that by which it breaks contact, it is liable to carry back on the contact surfaces the non-conducting metallic oxide formed by the repeated rupture of a circuit. The form of contact which more nearly fulfills the above requirements is that of the so-called "knife-switch." This contact should be formed by two or more pieces of tough and elastic metal of good conductivity, held rigidly by one end, while the free ends press upon opposite sides of the switch-plate, as in the usual type. These pieces should be of sufficient thickness to instantly carry off the heat produced by the rupture of the circuit, and prevent unnecessary burning at the point of rupture. While the contacts of the knife-switch are desirable, its non-automatic action is objectionable, when used on comparatively small currents by the average user. Currents of large capacity are supposedly handled by persons of judgment and with knife-switches in which a spring is used to assist the "throw." Under such conditions they answer the usual requirements.

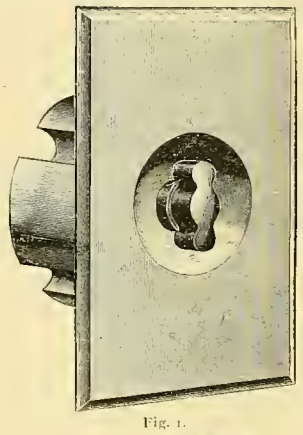


Fig. 1.

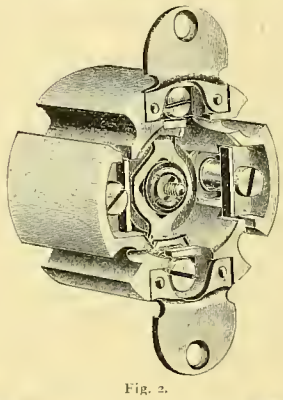


Fig. 2.

Fig. 3.

SNAP SWITCHES.

From the foregoing facts it would seem that the switch best adapted for everyday use, by everybody, on small currents, say up to 50 amperes, is one in which the switch-plate is carried automatically and surely into contacts which make contact at all times and under all conditions, and one which breaks the circuit rapidly and with equal certainty, simply by the turn of a handle

leaving nothing to the possible carelessness of the operator.

The manufacturers of the well-known Hart switch, recognizing the present requirements as to quality in all the details of construction, are bringing out a new line of switches which seem to embody all the essential features of a good switch. The flush switch illustrated herewith is a sample of the new line. This switch, in addition to heavy and durable mechanism and contacts calculated to stand severe service, is also "indicating." When the switch is "on," the handle stands as shown in Fig. 1, and at right angles to that position when the switch is "off," the movement of the handle being continuously to the right by quarter turns, with no possibility of its stopping in any intermediate position. The handles of all the switches of the same capacity are interchangeable without affecting the indicating feature. The same rule applies to switches in gangs. The handles are of the self-adjusting type heretofore used on Hart switches.

Fig. 2 is a cut of the 10 ampere double-pole switch with finished face plate removed, showing the mechanism and contacts enclosed by the base, which is one piece of porcelain. This base is provided with channels for the wire, the bared ends of which are clamped under binding screws, accessible from the face of the switch after it is put in position in the wall. This feature greatly facilitates the installation of the switch, and especially of switches in gangs. Any switch in a gang may be connected up or disconnected and removed without disturbing the others.

Fig. 3 is a cut of the type of contact used. Each binding post is provided with a pair of spring bronze clips *c*. Each end of the switch plate *B* is carried between a pair of these clips by the strong and instantaneous action of the switch mechanism. The connection thus made is practically perfect. The double-pole switches are "double-pole," "double-break" and "double-contact." Single switches and gangs of all sizes are carried in stock, with face plates of any of the standard finishes. Any special finish can be furnished promptly.

A line of iron wall frames and iron switch boxes for use with iron-armored conduit is also provided. No flush switch should be placed in a plastered wall without the use of such frame or box or its equivalent, to provide a secure attachment for the switch and to prevent the plaster from crumbling around the edges of the opening.

The Hart & Hegeman Manufacturing company, which has headquarters in Hartford, Conn., feels that in producing this new line of flush switches it is taking one more step in the direction of the maintainance and improvement in the former good construction of the Hart switch, and it is confident that the already large number of the users of that switch will be increased.

Taber & Mayer Telephone Apparatus.

The telephone apparatus made by the Taber & Mayer Telephone company at 185 Franklin street, Boston, Mass., will undoubtedly interest those who desire to keep pace with the production of instruments of varied types. Four styles are shown herewith.

Fig. 1 shows the Taber & Mayer "pony" vibrating bell set, with a highly polished oak or walnut box with long-distance mouthpiece, and with transmitter mounted on a box with automatic switch. This is the instrument which has been placed in so many of the large establishments in New England for inter-communicating use. It can be used on an inter-communicating system with the battery located at one point by running one additional wire, in which case three or four cells of battery will operate 10 to 25 instruments. Fig. 2 represents the desk set, which is a compact instrument 11 inches high and is particularly well constructed. Fig. 4 shows an exchange instrument with long-distance transmitter and automatic switch. Fig. 3 illustrates a new watch-case receiver which is 2 1/8 by 7/8 inches in dimension, the weight complete being six ounces. It has a hard rubber cap, silk-wound double-pole magnets and inside binding post connection. The magnets will sustain eight ounces. This concern has in preparation a number of other articles in the telephone line which will be placed on the market soon.

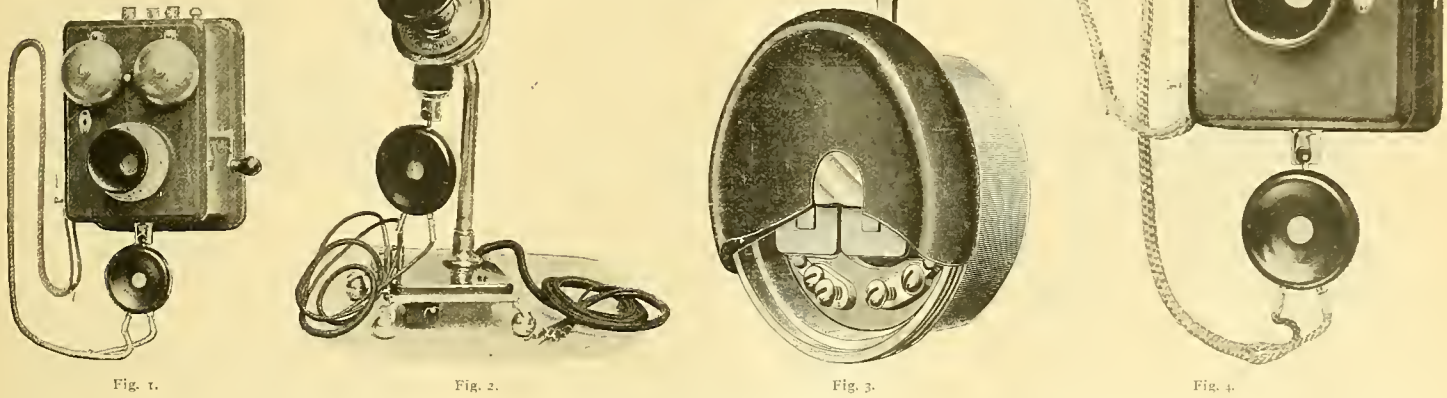


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

TABER & MAYER TELEPHONE APPARATUS.

A PORCELAIN LAMP BASE.

A Porcelain Lamp Base.

In placing on the market its T.-H. porcelain lamp base, the Bryant Electric company claims to have "enabled the trade to take a decided step in advance in the art of electric lighting." The illustration represents a standard lamp fitted with the new base, which not only shows it to be thoroughly artistic and well proportioned, but seems to indicate that the union of glass with a fine grade of glazed porcelain is much more effective than with brass.

The method of fastening the brass ring to the porcelain is very ingenious, the union being so rigid that it is almost an impossibility to remove it. In point of insulation the new device is said to be greatly superior to the old style of base, making it unusually desirable on a 220 volt system and valuable for use in street railway or outdoor sign work, mills or cellars where acid fumes and damp or salt air cause corrosion. The fact that it can be readily cleaned is also an advantage over the brass bases, which tarnish very quickly—an advantage which can be appreciated by users of fine fixtures.

Serious tests, under varying conditions, have been made by several of the largest manufacturers of lamps in the country, and the universal opinion, the Bryant company states, is that the new base is superior in every respect to the brass base. The manufacturer is making the bases only for the manufacturers of incandescent lamps, and any requests for prices or additional information should be addressed to the lamp manufacturers.

A Large Nugget of Platinum.

A recent shipment of crude platinum consigned to Baker & Co., the platinum refiners of Newark, N. J., contained a nugget which is believed to be the largest ever received in this country, and it is now on exhibition at the firm's New York office, 121 Liberty street, where it is attracting the attention of metallurgists and the admiration of all who are interested in mineralogical curiosities. This nugget, illustrated herewith, is, as usual, of irregular form, measuring approximately three inches in length, two inches in width and three-quarters of an inch in thickness, and weighs nearly two pounds. It is interesting to note the increased and growing importance of platinum in the arts. It ranks fourth as a conductor of heat and sixth as a conductor of electricity among metals. It expands and contracts under variations of temperature less than any other metal, and because of this fact, its high fusing point and non-oxidability, platinum is the only metal that can be successfully sealed into glass vacuum apparatus. Its rate of consumption may in a sense be regarded as an accurate index of the progress of civilization. Eminent statisticians have been wont to measure such progress in terms of pounds of iron consumed per capita; but it should not be forgotten that the consumption of iron, aside from abundance of the ore, has been and must continue to be dependent upon the cheapness and quality of the product.

A LARGE NUGGET OF PLATINUM.

The dental and electrical industries, which have pro-

gressed so rapidly within recent years, are said at the present time to consume, in the United States alone, more than half of the world's supply of this metal. Platinum has played a most important part in the development of the incandescent lamp. It was early used as the light-giving body of the lamp, but subsequently yielded this position to carbon because of the latter's higher electrical resistance, higher fusion point and lessened cost. Although now occupying a less prominent position in the modern lamp, it is nevertheless one

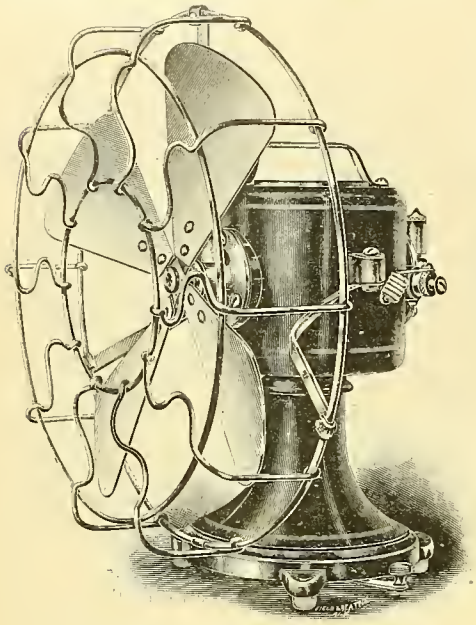


FIG. 1. PARAGON ELECTRIC FAN APPARATUS.

considered as essential in the construction of a successful lamp. Many devices have been tried to avoid its use but without commercial success. Metal conductors are required to convey electric energy through the glass walls of the incandescent lamp to the light-giving carbon filament within. Since the maintenance of a vacuum within the lamp bulb is essential to the life of the lamp, it can be readily understood that the leading-in wires sealed into the glass must have a higher fusing point than glass; must unite closely with it, hence must not oxidize at high temperatures and last, and a most important feature, the metal must expand and contract under variations in temperature so nearly at the same rate as the glass in which it is imbedded as to insure freedom from crackage of the latter and consequent leakage of air into the lamps. Here again platinum proves to be the only metal that fulfills all of these essential requirements and hence its continued and increas-

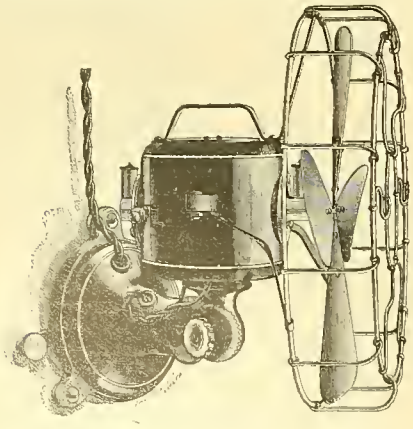


FIG. 2. PARAGON ELECTRIC FAN APPARATUS.

ing use in spite of its high cost, which a limited supply enforces. Radical changes in the construction of incandescent lamps have reduced the consumption of platinum per lamp enormously, but on the other hand the production of lamps has increased in greater proportion, and the aggregate consumption is greater than ever before in that industry. The telephone, telegraph and in fact almost all of the electrical industries are yearly making heavier demands upon the limited supply of the metal.

The latest application of the peculiar properties of platinum is due to Röntgen's discovery that certain invisible rays of energy when allowed to fall upon one of the double salts of platinum (barium-platino-cyanide) renders it luminous so that a screen of paper covered with this salt and exposed to the action of Röntgen rays serves for the production thereon of a shadow picture of many objects of variable density which may be interposed between the screen and the source of the Röntgen rays. Metallic platinum is also a most important factor in the construction of Röntgen ray apparatus, both as a means of conveying electric energy into the vacuum chamber and as a source of excitation of the Röntgen rays.

Paragon Electric Fan Apparatus.

The Paragon electric fan which is shown in the accompanying illustration (Fig. 1) is offered for sale by J. P. Williams, general agent, with offices at 39 and 41 Cortlandt street, New York. In its construction great care has been taken in selecting materials that are only the best, and the workmanship is equal to any that is offered for sale. All parts are made interchangeable, and can be renewed without returning the fan for repairs, thereby saving a large amount of expense where accidents occur to the fan motors. The Paragon has flat carbon brushes, locked nut commutator and two speeds with 12, 14 and 16 inch fan and guard. The motor is wound in series. This, it is claimed, will give greater efficiency than any

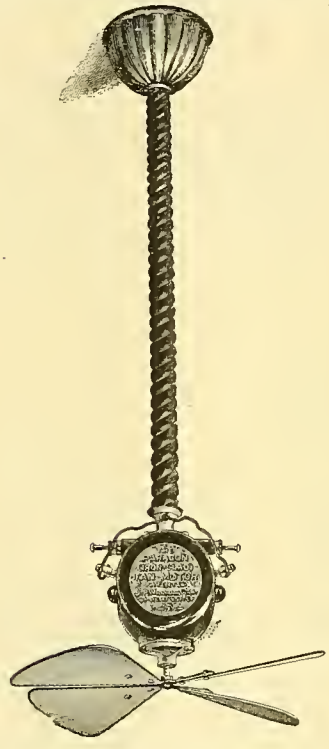


FIG. 3. PARAGON ELECTRIC FAN APPARATUS.

type thus far offered for sale. One type can be suspended from the ceiling with a 36 inch sweep.

Fig. 2 illustrates the universal joint Paragon fan which can be placed in any portion of the room and adjusted to any angle that is desired. Fig. 3 illustrates a new type of rigid and joint ceiling buzz fan which is made from 12 to 16 inches. These are made in response to a large demand for this particular style of fan. The new Paragon wood-blade ceiling fan is operated by the same type of motor, and possesses all of the merits that are claimed for the other styles.

A particular feature which is noticed in the Paragon motor is that the flat end bearing brushes are made so that they can cover the whole width of commutator, together with the locked nut adjustment. This fan is the result of several years' experience in this field and a careful consideration of the requirements of the trade. The makers have endeavored to furnish as near a perfect motor fan as money and care can produce.

New X-Ray Apparatus.

The Swett & Lewis company of 11 Bromfield street, Boston, Mass., has recently perfected its new static machine for X-ray work. It is neat in design and substantially constructed, being adopted as a substitute for the more expensive coil. It not only produces the same results but is said to give clearer and sharper definitions. The revolving plates of hard rubber, especially vulcanized for this purpose, are 17 inches in diameter, mounted upon ball bearings, and are geared up in the ratio of 1 to 18; that is, one turn on the hand-wheel gives 18 revolutions on the plates. The machine can thus easily be run at a speed of nearly 2,000 revolutions per minute even by hand. The result of this high speed is a remarkably steady discharge, and therefore gives a constant glow in the Crookes tube. The best speed is between 1,500 and 2,000 revolutions per minute; if run at a higher speed there is a discharge across the plates and only a short spark can be obtained. The driving gear is under the base. (The hand wheel can easily be taken off and a pulley substituted if it is desired to run the machine by power.) All metal parts are nickel-plated and the whole is mounted upon a mahogany base.

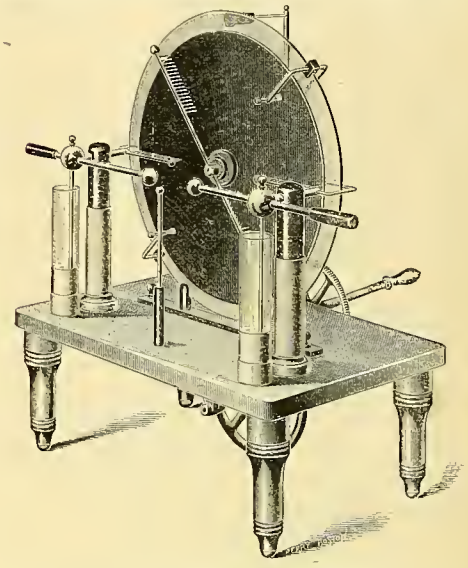


FIG. 1. NEW X-RAY APPARATUS.

A protecting case is furnished with each machine. The machine is built in two sizes at present. The No. 2 has two revolving and two stationary plates, while the No. 1 has but one set of plates. The diameter of the plates is the same on both machines. The stationary plates are of glass on all machines, as no substitute has been found to work satisfactorily.

Fig. 1 shows the machine without case. The new fluoroscope, illustrated in Fig. 2, which this company manufactures, is manufactured of stiffened pasteboard, and of different design than those which are ordinarily in use, having more of a spread and better concentration.

Mr. Yerkes' Views on Municipal Control.

Mr. Yerkes, in his talk with members of the Legislature upon the merits of the Humphrey bills, said there were many features of these measures which he approved, while there were others in which he did not believe at all. He thought the state of Illinois might learn a valuable lesson from New York, Pennsylvania and Massachusetts in the matter of according corporations fair and just treatment. Concerning the subject of a

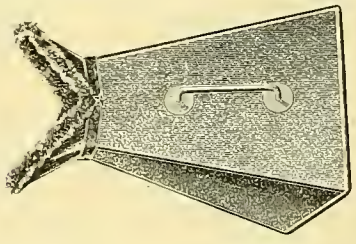


FIG. 2. NEW X-RAY APPARATUS.

city conducting a lighting or street railway plant, he said:

Several gentlemen have spoken to me about municipal ownership of street railroads, and I will touch briefly on that subject. I believe that the system in this country, the policy of encouraging corporations to own property, is one of the great foundations of our republican form of government. In Europe the socialist complains because the government owns everything. In this country the socialist complains because the government does not own everything. Our corporations are owned by the people, and the profits of them go to the people. They are the means by which a man can invest his money. He is not compelled, as in the old countries, to invest his money with the government. In Germany, very much so in France, Russia, and most of the governments of Europe, the only place where a man can invest his money except in trade—and not always in trade—is the government itself; while here we have these great corporations, where every man, woman and child who has a few dollars can put their savings and get interest upon them. Four thousand people ow

our corporations—more than that, for some of the 2,000 bondholders are also stockholders, and no doubt there are 5,000 people who are the owners of our corporations.

Now, in regard to municipal control, I have had in my life an impressive object lesson. It happened in the city of Philadelphia, which is the only place that I know of municipal control being thoroughly tested. In the early days Philadelphia was composed of a number of districts. There was the city of Philadelphia and then a number of towns, composing the county of Philadelphia, five miles wide and 20 miles long. Each one of these districts has its gas works. The gas works were operated under charters that were given to them by the state, and each one provided that at any time the municipal authorities wished to purchase these gas works a committee of arbitration should be appointed in the usual way. There was nothing done in that way until the active incorporation went into effect in the city of Philadelphia, which took the whole of the county. Then the City Council passed an ordinance directing that the gas works of these different districts should be bought. Boards of arbitration were appointed. The gas works company in Liberty, for instance, had their arbitrator; the city appointed its arbitrator and the two men appointed the third. The city got the worst of it. All the gas plants of the city of Philadelphia were merged into the city plant. The law provided for a board of trustees to operate the plant, and those trustees were to be appointed by the City Council. The result was that the City Council was elected by the gas trustees. The City Council appointed the trustees which the trustees said they should appoint. Consequently the city of Philadelphia was run by the gas trust of Philadelphia for fully 25 years, so that the price of gas in Philadelphia never got below $1.50 a thousand until the new charter went into effect, when the gas trustees were obliterated and the gas works put under the control of the Department of Public Works. When this came to pass it was found that the gas works was practically worthless, and the city of Philadelphia is to-day buying from a private corporation more than one-half of all the gas it distributes. That is my object lesson in regard to municipal control.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 20.—On reassembling last Wednesday the state railroad commissioners listened to arguments for and against the application of the Metropolitan Street Railway company for permission to change its motive power from horses to the trolley conduit system on Sixth, Eighth and Ninth avenues. There were several objectors. The attorney for the Third Avenue Railroad company opposed the application on several grounds, among them that the Eighth avenue, Ninth avenue, and Sixth avenue companies had no corporate power to make the application, and that the leases did not give the Metropolitan company such right; that the consent of the Park Board and the Board of Electrical Control should be obtained, and that consents of property owners along all the lines had not been secured. John M. Scribner and ex-Lieutenant Governor Sheehan appeared for the Metropolitan company and Mr. Scribner made the argument for the application. He declared that the company had secured the requisite number of coosents of property owners and that there was no reason why the application should not be granted. The commission will hand down a decision before April 1st, it is said.

The Board of Aldermen, as a committee of the whole, is considering the request of the Rapid Transit commissioners for permission to build the underground road according to the ameoded plan recently adopted. The expense, including equipment, is placed at $33,000,000, and three years is stated to be the time necessary for building.

On Wednesday evening the new home of the Engineers' club was formally opened. The new clubhouse was formerly the home of J. Coleman Drayton, and is on Fifth avenue, near Thirty-fifth street. There are five stories. On the first floor are the reception room, the office, the dining hall and the cafe. On the second floor are the clubroom, parlor and library, all of which are tastefully appointed. On the third floor are the billiard, pool and private dining rooms and two other private rooms, and the fourth and fifth floors are devoted exclusively to rooms for the members. The officers of the Engineers' club are: President, Charles H. Loring; vice-presidents, David Williams and John Thomson; treasurer, A. C. Rand; secretary, George W. Bramwell; chairman of the house committee, J. C. Kafer. The club numbers 650, and its membership embraces engineers—civil, mining, electrical, mechanical—architects and others engaged in professions and pursuits which are brought into contact with the engineering profession.

The Rockland Telephone & Telegraph company, which has been doing business in Nyack and other parts of Rockland county, has sold its property and business to the New York Telephone company of this city. William H. Russell, treasurer of the Rockland Telephone & Telegraph company, said that the Rockland company had been endeavoring to conduct the telephone business at rates ranging from $2 to $3 a month, and was unable to make a success of it.

The "ticker" question has been settled, for the present at least, by the decision arrived at yesterday, of the governors of the New York Stock Exchange, not to renew the contract with the Gold & Stock Ticker company to distribute to outsiders the quotations of the exchange. The contract with the Ticker company expires on June 30th, and it was necessary to give the company 90 days' notice of the abrogation of the contract. The Gold & Stock Ticker company is controlled by the Western Union Telegraph company and has supplied outsiders with the quotations of the exchange. The New York Stock Quotation company, which is the ticker company controlled by the governors of the exchange, and of which company John W. Mackay of the Postal Telegraph company is a stockholder, will continue to supply the quotations to members of the exchange. It is said, however, that the governors will ultimately sign a new contract with the Gold & Stock Ticker company, provided a clause which is in the contract to be abrogated on June 30th shall be lived up to in letter and in spirit. This clause provides that before the Gold & Stock Ticker company places one of its instruments with a customer it shall first have the approval of the governors of the exchange. The governors say that this clause has not been lived up to, but on the contrary has been regarded by the Gold & Stock Ticker people as a dead letter and as an obsolete feature of the contract. If a new contract is signed with the Western Union people the governors, it was said, will insist that the clause requiring their approval before an instrument is leased to any customer shall be rigorously enforced.

M. S.

Washington, D. C.

WASHINGTON, March 20.—One of the important items for the District that has been enacted into law is the amendment offered in the Senate by Chairman McMillan of the District committee concerning the extension of fire-alarm telegraph. This will enable the 150 applications for telephones which are now before the commissioners to be acted upon. Many senators believe also that the arrangement in the law about the stringing of fire department wires will be of great benefit to the city.

The recent debate in the Senate on the electric lighting schedule of the District appropriation bill resulted in a victory for the Potomac Heat & Power company. As the sundry civilbill was reported by the committee on appropriations to the Senateit contained this paragraph relating to electric light companies: "Provided that hereafter there shall be no extension of electric lighting service, and it shall be unlawful to lay conduits or erect overhead wires for electric lighting purposes in any road, street, avenue, highway, park or reservation, except as hereafter specifically authorized by law. Provided, however, that the Commissioners of the District of Columbia are hereby authorized to issue permits for house connections with conduits and overhead wires now existing adjacent to the premises with which such connections are to be made, and also permits for public lighting connections with conduits already in the portion of the street proposed to be lighted; and nothing herein contained shall be construed to effect in any way any pending litigation involving the validity or invalidity or legality of the construction of any conduits made since June 18, 1896." The effect of this amendment, as was clearly showo in the two hours' debate that followed upon it, is to leave the Potomac company in full possession of the field it has already won. The debate at times took an amusing turn, and when near a vote a brisk colloquy occurred between Senators Hill and Gallinger. Senator Hill said that it was not for him to defend the commissioners, but that he could, if he were not reluctant to enter into debate on this day, show by the record that his friend from New Hampshire changed his opinion upon the question of competitive light companies, and that "his conversion was quicker than that of Saul of Tarsus." "Will the senator deoy," pursued Mr. Hill, "that he was at one time the champion of a new and additional gas company in this city?" "Does the senator desire an answer?" asked Mr. Gallinger. "On some other day; not to-day," replied Mr. Hill. "I am afraid the senator will not be here at that other day," said Mr. Gallinger, referring to the expiration of Mr. Hill's term. "I will be here three or four days," said Mr. Hill, "and I hope the reply will not be put off longer than that. I have no doubt my friend is very glad to be relieved of my presence after the 4th day of March." "Oh, no," returned Mr. Galliger; "we all enjoy the senator from New York; he is very amusing." "The senator does not act as though he enjoyed my presence," insisted Mr. Hill. Senator Hill, after a few other remarks, closed by congratulating the people of the District and the Senate that they were to have "two electric light companies competent to do business in aoy part of the District, and instead of being a calamity and misfortune, it will prove to be a benefit to the people of the District."

The complimentary use of a telephone will be a thing of the past in Washington after April 1st. This is the result of an agreement reached between the Chesapeake & Potomac Telephone company and the Pharmaceutical association of the District of Columbia at a meeting held in the National College of Pharmacy. After the date specified any drug store owned by a member of the association will be equipped with a patent dime-in-the-slot telephone, which will only work when encouraged to do so by the dropping in of the silver piece. Three-fourths of the druggists of the city are members of the association and are bound by the agreement. Those who are non-members may be forced into the arrangement through fear of having their telephones removed in case of a refusal to conform to the wishes of the company. Similar pressure will be brought to bear on all other merchants and users of private telephones to prevent them from extending any courtesies to friends in the way of complimentary use of a telephone. Speaking from the druggists' point of view regarding the proposed change, R. N. Harper, president of the Pharmaceutical association, said. "While the association has agreed to the change, we wish it distinctly understood by the public that the new order is not of our seeking. We are offered the choice of two propositions, and we accepted that which we considered best for both ourselves and our patrons. The company proposed that either we should accept the system adopted or take our telephones on the same conditions as private residences and other lines of business. That is, every use of the telephone for other than our own private business should be charged for at the rate of 10 cents. Any violation of the rule would entail forfeiture of contract with the company and the removal of the telephone. Under the agreement made we are allowed to call up a doctor or another druggist free of charge. We are also allowed to call up the Emergency Hospital, police, fire, or health department free of charge. The entire receipts from the public go to the company. We simply get free use of the instrument in the cases enumerated for the privilege of allowing the instrument to be placed in our stores The company will enforce the rule that private telephones can only be used to transact the personal business of the renter. I understand the company has been making a quiet investigation for several months as to the number of calls coming from the telephones now in use, and in every case where an increase is noted after the new rule goes into effect an explanation will be asked and an increased rental demanded. With the druggists it was simply a case of accepting the slot telephone or doing worse, both for himself and his customers who might wish to use his telephone. By waiving the right to call up a doctor or a customer free of charge we were offered 10 per cent. for the receipts, but we preferred to lose that revenue in order to accomodate our friends and customers."

T. I. P.

News from the South.

MEMPHIS, March 19.—A war has been on here for a few weeks between the Electric Light & Power company and two or three of our wiring houses. So fierce has it been that the president of the Electric Light & Power company, Gen. Carnes, has organized the Electric Supply company and will do wiring and supply the trade and, he says, "make it hot" for some of them. I fear that this will result in a competing plant being started here, for two of the companies which the general makes war on are old and well established concerns.

D. G. Stoddard of the Metropolitan Electric company of Chicago was in the city a few days ago and secured a few orders.

M. A. Dunivin, late owner of the Jonesboro, Ark., telephone exchange, has secured a franchise and 110 subscribers to an exchange at Cape Girardeau, Mo., and will remove to that city.

C. D. Riggs, representing the Electrical Engineering

& Supply company of Syracuse, N. Y., was in our city recently and secured a few good orders, one from the new Electric Supply company.

Geo. W. Scheuny & Co. have their telephone exchange at Corinth, Miss., in operation. They have a 150 number switchboard of the Utica company's make. Forty-eight telephones are now in service.

John Miller, who has worked several years for the Cumberland Telephone & Telegraph company, and later with the Telephone & Electric Specialty company, has left Memphis to take charge of the Corinth, Miss., exchange. He will manage the business out there for Scheuny & Co.

Mr. Couch, of the firm of Whitman & Couch of Boston, was in the city a short time since showing samples of the Ericksson Swedish telephones. He secured several orders.

The Mutual Telephone company, using the American Electric Telephone company's instruments, will soon start an exchange at Yazoo City, Miss. It now has 140 subscribers and expects to increase the number to 200.

The People's Telephone company of Jackson, Miss., is now working on an exchange for Vicksburg with flattering prospects. That company uses the American Electric Telephone company's instruments. R.

Northwestern Notations.

MINNEAPOLIS, March 20.—It is rumored that an electric light plant will be installed at Emerado, N. D.

Olalaska, Wis., is considering putting in an electric lighting plant.

Outsiders contemplate putting in an electric light plant at Valley City, N. D.

Mrs. Mary Leighton secured a verdict against the Western Union Telegraph company, at Ottumwa, Ia., for $232.52 damages for delay in delivering a telegram. The plaintiff is the owner of a brick block, and negotiations were pending for the rental of the building. Her agent submitted an offer by wire to Mrs. Leighton to Pasadena, Cal., and she answered, but the message did not reach the destination for several days, being delayed in transmission. When it was delivered the negotiations had been discontinued.

Pine City, Minn., has voted a bonus to St. Paul capitalists to put in a grist mill with an electric light plant in connection.

The street railway company at Butte, Mont., has been granted a renewal of its franchise, running for 30 years.

A company is being organized at Houghton, Mich., to build an electric railway to Hancock.

The electric light plant at Mt. Vernon, Ia., has been completed and put in operation.

F. H. Stanard of Waterloo, Ia., has been consulting Eckert, Hortoo & Roberts at Northwood, Ia., with a view to putting in an electric light plant.

George W. McCord of Logan, Ia., will ask a franchise for electric lighting at Bedford, Ia.

The Light, Heat & Power company of Oskaloosa, Ia., is the name of the reorganized Oskaloosa Power & Land company.

The bank above the tailrace of the artesian power plant of J. C. Hubinger at Keokuk, Ia., caved in recently, throwing a 5,000 light alternator and a street railway power generator into the stream. Neither was in use at the time of the accident and so no delay in the service was caused. The electric street railway service in that place has been discontinued.

The Peninsula Electric Light & Power company of Marquette, Mich., has reduced its rates 10 per cent.

The Maquoketa and Canton Electric Light & Power company has been incorporated at Maquoketa, Ia., with $60,000 capital stock. The Canton water power will be used and the Barnes Electric company will be absorbed and its plant retained for use in an emergency.

An electric light plant is assured for Glendive, Mont.

The power and car houses for the Citizens' Traction company of Oshkosh, Wis., are completed.

Mayo G. Seevers has assumed the management of the Muscatine, Ia., Electric Railway company.

Citizens of the Seventh ward appointed a commission of engineers to report on the feasibility of running electric cars up the Selby avenue hill in St. Paul. The commission report that it is entirely feasible, by employing a device to overcome the grade, but recommends no special device.

J. M. Nikolai of Madison, Minn., contemplates putting in an electric light plant with his flour mill.

The electric light and power commission of Marquette, Mich., estimates the cost of repairing the water power for the lighting plant at $35,331.

It is reported that the Oshkosh & Omro Electric Railway company will soon begin construction on its line between Oshkosh and Omro, Wis.

An electric light plant is projected for Devil's Lake, N. D.

The American Loan & Trust company of Boston has began suit against the Burlington (Iowa) Electric Street Car company to foreclose a mortgage. It is the first step toward a reorganization of the company, which will be followed by an extension of the line.

The St. Paul & Duluth Railroad company is reported to be considering equipping its White Bear Lake and St. Paul line for electric power.

The Gladstone, Mich., electric light plant was burned a short time ago. It is owned by General Manager Kendrick of the Northern Pacific railway and John Woods of Minneapolis, and it is believed that it will not be rebuilt.

Samuel Walters contemplates putting in an electric light plant at Eagle River, Wis.

Hancock, Mich., is considering putting in an electric light plant.

A Mr. Tomlinson of Iowa contemplates putting in an electric light plant at Woonsocket, S. D.

W. I. Gray & Co. of Minneapolis have the contracts to furnish electrical equipment for the new plants at Redwood Falls and Morris, Minn.

A. D. Stewart and J. C. Wells contemplate putting in an electric light plant and motor line at Sturgis, S. D.

An electric line is proposed at Park Point in Duluth, Minn.

The Minneapolis Street Railway company and the St. Anthony Water Power company of Minneapolis are considering bids submitted for furnishing the cable for the electric transmission plant to carry the power from the dam to the power houses of Minneapolis and St. Paul. It will take approximately 150,000 feet at a cost of about $1 per foot.

Mr. Buck of Reedsburg, Wis., contemplates putting in an electric light plant at Elroy, Wis.

Watertown, S. D., has been in hopes that some kind Samaritan would take the electric light plant and operate it, but the prospects are good for its remaining shut down for some time.

Two water power sites on the Michigamme river, in northern Michigan, have been surveyed by Engineer C. B. Pride of Appleton, Wis., who found that 3,227 and 650 horse power can be developed from them. The owners contemplate transmitting the power to Iron Mountain, Mich., and operating the mines there.

Edwin Pickthorn and A. S. Williams have been granted a franchise at Appleton, Minn., for an electric light plant, to be in operation by September 1st.

The bid of Fred A. Flint has been accepted for the plant of the Stillwater, Minn., electric railway for $4,700 and the assumption of $700 taxes. W. D. Scott of Crookston, Minn., is interested in the deal. The plant will be operated again.

Paul Gardner and James Walker will establish an electric light plant at Langdon, N. D., if a canvass reveals sufficient patronage.

A company has been formed at Two Rivers, Wis., to establish an electric light plant. Henry Kopplemann is interested in the enterprise.

F. W. Epley has been granted a franchise for an electric light and power plant at New Richmond, Wis.

J. C. Wells and A. D. Stewart have been granted a franchise for an electric light plant at Sturgis, S. D., and for an electric railway line to Fort Meade.

It is proposed at Grand Forks, N. D., that 15 business men advance $1,000 each for the erection of an electric light plant and take the rental that is now being paid for gas lighting until the amount be liquidated. The city is bonded up to the limit and so cannot secure a plant that way.

The Council of Beaver Dam, Wis., has voted to have plans and specifications prepared for an incandescent light system.

Nauvoo, Ill., will vote at the April election on electric lighting.

It is reported that the Wisconsin Central Railway company contemplates the purchase of the St. Paul & Suburban electric line, running from St. Paul to North St. Paul.

Winthrop, Minn., has voted for electric lighting.

The application for government aid for the construction of a telegraph line to Fort Francis, Ont., near the Rainy Lake gold regions, suggests that this will no be the first telegraph line to that lonely region. Twenty-six or 27 years ago when the first Red River rebellion broke out in Manitoba the British government was very anxious to get connection with Fort Francis, and with the secret permission of the United States government a wire was strung from Roseau Lake and thence along the south shore of Lake of the Woods, and the south bank of Rainy River to a point near the Little Fork river, where the project was abandoned as the rebellion was over. The wire was strung through the trees and many a timber explorer was surprised to find in the forest primeval a glass insulator on the regulation bracket and pin. The Indians generally appropriated the wire.

A. Tompkins will build an electric light plant at Minot, N. D.

Shelby, Neb., has granted a franchise for electric lighting.

A company is being formed in Two Rivers, Wis., to furnish electric light and power.

The armature in the Brainerd, Minn., city electric light plant was burned out this week, the second time in a month, and as there is not another on hand, the city will be without light until it is rewound.

The First National Bank of Marshalltown, Ia., has equipped its vault with an elaborate burglar alarm system which is operated by electricity. Connected with the vault is a large 18 inch rapid ringing gong, which sounds at once should anyone touch the vault while the current is on.

An electric light plant is promised at Lenox, Ia.

H. D. McCulloch of Rockford, Ill., the principal creditor of the Stevens Point Lighting company of Stevens Point, Wis., has applied for a receiver for the company.

The city of Elroy, Wis., has received a proposition for electric lighting.

Valley City, N. D., is figuring on a $5,000 electric light plant.

The Mauston Milling company has been granted a franchise for electric lighting at Mauston, Wis.

President Geo. W. Blabon of Philadelphia, president of the Janesville, Wis., Street Railway company, will rebuild the line as soon as the frost is out of the ground.

Tomah, Wis., has had plans and specifications for an electric lighting plant prepared by W. H. Vansicker.

Robert Holliday has made a proposition to establish an electric lighting plant at Baron, Wis., if the city will take a certain number of lights.

George B. Wheeler, receiver of the Eau Claire, Wis., Street Railway Light & Power company, has transferred the street railway to H. M. Bates of Boston, as trustee. A new company will be organized to operate the road, which is to be rebuilt.

The Great Falls Electric Power company of Great Falls, Mont., has secured the contract to furnish power for the great silver smelter, using the alternating current. Several new and larger generators will have to be put in to meet the increased demand for power. The company is figuring on a contract to furnish power for the operation of the Montana Central railway shops also.

The recent heavy snowstorm did not cripple the Minneapolis electric lines or wires as much as might have been expected. The street railway company kept a dozen snow plows running all night and did not abandon any of its lines. In St. Paul the street car service suffered more and a number of lines were badly hampered. The interurban line between Minneapolis and St. Paul was hung up about six o'clock P. M.

C.

PERSONAL.

Henry C. Payne, Milwaukee's street railway magnate, has been offered a position in the diplomatic service by President McKinley, it is said.

President George A. McKinlock of the Central Electric company, after an extensive business trip to New York and other points, is spending a few weeks at Pass Christian, Miss.

H. L. Doherty of Madison, Wis., and W. Worth Bean of St. Joseph, Mich., both prominently identified with the Northwestern Electrical association, were in Chicago last week.

Out-of-town visitors registered at the office of the National Electric Light association, New York, last week included A. Anderson, Boston, Mass.; L. Duncan, Baltimore, Md.; A. M. Young, Waterbury, Conn.; S. Whittaker, Newark, N. J.; A. J. Belden, Syracuse, N. Y.; H. Lewis, Philadelphia, Pa.

H. Russell Smith, the mechanical and electrical engineer whose electro-magnetic elevator attracted so much attention when described in the WESTERN ELECTRICIAN last December, has opened an office at 759 Rookery, Chicago, for the practice of mechanical engineering.

Especial attention will be paid to elevator and hoisting plants.

Frederic Nicholls, president of the National Electric Light association, was in Chicago last Saturday. He was on his way home from the Pacific Coast after a five weeks' trip through the far West. President Nicholls was exceedingly hopeful of a fine meeting of representatives of the electrical interests at Niagara Falls in June.

Chicago was honored by the presence of Alexander Graham Bell of telephone fame last week. Dr. Bell and N. Konishi of the Imperial School of the Deaf and Blind of Japan were given a reception at the McCowan Oral School at Sixty-sixth street and Yale avenue, Englewood. After lunch Dr. Bell gave a brief address on matters of interest pertaining to the work in behalf of the deaf and dumb, in which he is so deeply interested. He was followed by Mr. Konishi, who told of the work in the imperial schools in his native country and of his efforts to learn the best uses in this country, which is still far ahead of all others, so that it can be applied to the same subject on his return to his native land.

Colonel James A. Russell, who died in New York recently, had much to do with the introduction of the electric light. Since 1892 Colonel Russell had been a helpless invalid, owing to an illness contracted by exposure while in the Army of the Potomac. His death resulted from pneumonia. At the close of the Civil War Colonel Russell spent many years in Washington, returning to New York to engage in railroading and other pursuits. In 1879 he became acquainted with Thomas A. Edison, and subsequently traveled extensively in the interest of the Edison Electric Light company. He established branches in nearly all of the principal commercial centers. Returning to New York, he assisted in the practical development of the system. Later he was actively interested in the company formed for the manufacture and introduction of the phonograph.

POWER TRANSMISSION.

The success of the operation of long-distance electrical transmission is perhaps best gauged by the opinion expressed by the company operating the plant. An extract from a recent letter regarding the operation of the Fresno, Cal., long-distance transmission, written by John J. Seymour, president of the San Joaquin Electric company, to the General Electric company, is in point: "It affords me great pleasure to write you regarding the successful operation of the long-distance transmission plant installed for our company. The entire plant as furnished has been in actual practical operation for a period of several months. The 35 mile transmission has given us no trouble whatever. Our load at present consists of 145 arc lights and 5,000 incandescent lights and 410 horse power in motors, the latter including 180 horse power for the Sperry flour mill and 75 horse power for the city pumping plant. All of the machinery doing this work has worked with perfect success from the start. The incandescent lights have most of them been newly wired in, thus enabling us to properly balance the load and the regulation has given us no trouble whatever. During extensive tests it was impossible to find more than two volts variation between any lamps on the system. Lights so furnished seem to me to be better than incandescent lights usually furnished in San Francisco and other cities of the state."

ELECTRIC RAILWAYS.

Judge Smith of Dallas, Tex., granted a petition for a receiver for the Dallas City Street Railway company, applied for by the Mercantile Trust company of Baltimore, Md., which holds $250,000 worth of the company's bonds, on which default of interest has been made. The road has 27 miles of track and electrical equipment.

The contracts have been closed for the complete construction of the electric line on Wyandotte street, Kansas City, Mo., from the Grand Central depot at Second street to the southwest boulevard, and of the boulevard line from Rosedale to Nineteenth and Main streets. In the construction of these lines and the first cost of the active operation of them, about $200,000 will be expended. The contract price for the roadbed on Wyandotte street amounts to $110,000, the overhead work, wiring and poles on Wyandotte street and the boulevards $70,000, and the new cars and extra apparatus required for the operation of the roads to at least $20,000 more. The limit fixed by the contracts for the completion of all the construction is May 1, 1897.

The Tonawanda Electric Railroad company of Tonawanda, N. Y., and the Tonawanda Street Railroad company of North Tonawanda, N. Y., have been granted the privilege of crossing the bridge across Tonawanda creek. Workmen are now engaged in strengthening the bridge for the extra load brought on by the street railroad traffic, and will have it completed in about one week, when the two roads will be in operation over the bridge, giving through service from Cratwick and North Tonawanda to the Buffalo city line. It is contemplated that the line of these two roads will be consolidated and extended to Niagara Falls, forming a through line from Buffalo to Niagara Falls, and will be operated under the name of the Buffalo, Tonawanda & Niagara Falls Electric Railroad company. Much of the right of way has already been secured and, the preliminary work is being pushed forward as rapidly as possible. The lack of permission to cross the bridge referred to has been a great detriment to the roads in the past. This bridge will be the means of giving better service to the public and a better revenue to the company.

The East Penn Traction company of Yardley, Pa., has elected the following-named officers and directors: A. S. Cadwallader, Yardley, Pa., president; Walter R. Johnson, Hulmeville, Pa., vice-president; J. Uhle Bethell, Philadelphia, secretary; E. W. Meloney, Yardley, Pa., assistant general manager; John T. Fish, Fallsington, Pa., T. Howard Atkinson, Buckingham, Pa., W. R. Andrews, George D. Armstrong, Robert E. Plewe, Dr. S. Edmund Long, Walter Brown, William C. Wilson, David Hanley Stone and Theo. T. Hansen, Philadelphia, directors. The company has filed and recorded plans for a number of lines and extensions. These lines connect the principal portions of Bucks county with its 80,000 population and the city of Trenton, N. J., with 70,000 people, and portions of Montgomery, Lehigh and Northampton counties with Philadelphia, and intersect with or cross practically all the street-car lines of that city. They cover a territory 25 to 30 miles wide and 50 miles long, embracing the best populated and most thrifty section of the country tributary to Philadelphia, and will afford greatly needed facilities of travel to this important district tributary to that city. The company's lines extending to South Bethlehem will also bring Bethlehem, Allentown and Easton in connection with Philadelphia by trolley. The company expects to begin operations in the spring, and the first line to be constructed will probably be between Trenton and Philadelphia and between Trenton, Morrisville, Yardley, Newtown and Doylestown. The remainder of the system will be built as fast as practicable, but the company will build in small sections between leading points and put each division in operation as fast as completed. A large portion of the rights of way has been secured and the franchises are now being applied for in the boroughs. The capital stock of the company is $350,000 in shares of $50 each, and will probably be increased to $1,000,000 at an early date. Bonds will only be issued for the actual cost of the construction, probably not exceeding $15,000 per mile, which is much less than for the average electric railway, but the great reduction in the cost of material and labor will enable the company to build cheaply. E. W. Meloney, of the Provident Electric Light & Power company, has been appointed assistant general manager of the company, with headquarters at Yardley, Pa., near Trenton, and placed in charge of its practical operations.

TELEPHONE.

Somebody in the office of the *New York Tribune* has been trifling with the long-distance telephone in all its costliness, for, is not the complaint written in words following? "When the telephone bills come into any office which has occasion to use the long distance service freely the figures are so big as to exasperate the most patient of men. So many millions of dollars of profits have been made already out of the telephone patents that it is now time for the telephone companies to reduce their rates extensively. If the companies voluntarily take the action which their duty to the public suggests, they will escape injurious measures in the Legislature. It is certain that the people of this state will not long endure the present excessive charges without emphatic protest."

The City & Suburban Telephone company of New York city has been incorporated to operate in New York, Albany, Brooklyn, Buffalo, Schenectady, Amsterdam, Fonda, Fort Plain, Little Falls, Utica Rome, Ogdensburg, Syracuse, Watertown, Oswego, Monticello, Binghamton, Auburn, Elmira, Geneva, Corning, Rochester, Olean, Batavia, Lockport and various smaller cities and towns throughout the state. The capital stock is $100,000, and the directors are Alfred H. Teller, Charles B. Minshull, Charles A. Teller and G. Rowland Munro of Brooklyn, Henry B. Oakman and Samuel Bear of New York, and Charles E. Tompkins of Jersey City. G. Rowland Munro, a director of the new company, said that the company had a contract with the Make-and-Break Telephone company of Philadelphia. The new company had purchased the rights to all patents, appliances and goods of the M. and B. system for the state of New York, and had laid out a route for the establishment of a telephone line.

TELEGRAPH.

The Western Union and Postal companies have had considerable trouble with the local authorities of Milledgeville, a town of 5,000 inhabitants, which was once the capital of Georgia. The council raised the annual tax of the telegraph companies from $50 to $100 each, and both corporations refused to do business on these terms. The superintendent of the Western Union company made a statement showing that the receipts of the Milledgeville office during the last year were only $700. Both companies will close their offices, and the town will be cut off from telegraphic communication with the rest of the world.

MISCELLANEOUS.

The General Industrial Association of Munich is preparing for an international exhibition of motors and machine tools to be held in that city from June 11 to October 10, 1898. Electric motors and electrically driven apparatus of various kinds will be shown. A jury appointed by the Bavarian government will award medals for exhibits of especial excellence.

TRADE NEWS.

The electrical trade in general and the telephone people in particular will be interested to know that M. C. Wheaton, who has been for a long time general manager and treasurer of the Stromberg-Carlson Telephone Manufacturing company, has disposed of his interest in that institution. Mr. Wheaton has not yet decided as to his future plans.

They say, "Good wine needs no bush." That must be the case with Eureka packing. The Hine & Robertson company, 76 Cortlandt street, New York, states that notwithstanding the many new kinds of packing put on the market the sales of Eureka constantly increase, and that the reports from the oldest and best engineers generally wind up with: "We have been trying some of the new kinds but are now going back to our first love, the old reliable Eureka."

BUSINESS.

The Highland Electro-Chemical Manufacturing company of Connellsville, Pa., says of its insulating soldering paste that it is free from acid or any ingredient injurious to insulation. The paste is in convenient form for use and is highly recommended.

The average working engineer can now easily secure an indicating outfit. Since the Robertson-Thompson indicator was put on the market at one-half the price and on easy terms when necessary, it is within the reach of everyone. The manufacturers are Hine & Robertson company, 76 Cortlandt street, New York.

W. W. McChesney, Jr., of the Huebel & Manger company, Brooklyn, N. Y., "made" Chicago last week. Mr. McChesney is on an extended trip for his company and states that the great army of buyers in the central and western states takes to Huebel & Manger specialties as effectively as usual. Mr. McChesney met with more than a fair measure of success during his stay in Chicago.

Another evidence of the high reputation of Simplex wire is to be found in the word just received from H. R. Hixson, western selling agent of the Simplex Electrical company, to the effect that the Illinois Trust and Savings Bank building, Chicago, which is being erected on the site of the old Grand Pacific Hotel, will be wired with "Simplex Caoutchouc." Mr. Hixson is one of those indefatigable men that every now and then surprises the trade by closing the handsomest sort of orders.

The American Electric Heating corporation of Boston announces as ready for market electric solder pots in two sizes, one to hold four pounds using 1¾ amperes at 110 volts; a larger size holds 10 pounds. They are easily portable and are well adapted for this work. It is clear that neither gas nor gasoline heated pots can compare with them for cleanliness, convenience or close regulation of temperature. These pots are especially useful in electrical repair shops for tinning wire and similar uses. They are fully guaranteed.

The Electric Appliance company is pleased to advise its customers and the electric railway trade generally that it has made arrangements with the Ohio Brass company to carry a complete line of the latter's railway specialties in Chicago stock. The electric railway trade will undoubtedly appreciate the advantage of being able to send large or small orders for the well-known Ohio Brass company's specialties, and have the goods shipped from Chicago on the day the order is received. Both the Ohio Brass company and the Electric Appliance company hope that this arrangement will be appreciated by the users of electric railway material.

The Chicago General Fixture company will be agent for all styles of fans manufactured by the Western Electric company during the coming season. These fans are very tastily designed, highly efficient and durable. The desk fans are made in two sizes, 16 and 12 inch, each with three speeds, and finished in polished brass or nickel plate, as desired. The ceiling fans have 60 inch sweep, with a switch at the base of the fan for controlling the current. This motor has two speeds. The column fan stands seven feet six inches from the floor, and is highly ornamental in design, and has two speeds. The motors are made for 110, 220 and 550 volt currents. A large stock of these motors will be carried to meet the demands of all customers.

A representative of the WESTERN ELECTRICIAN recently visited the factory of the Stromberg-Carlson Telephone Manufacturing company, 76 Jackson boulevard, Chicago, Ill., and found everybody busy filling orders. There have been recently some slight changes in the management of this company, M. C. Wheaton having withdrawn. The general management is now in the hands of F. A. Ross, who has had considerable experience in electrical enterprises, as well as other manufacturing business. With the addition of this new blood an aggressive policy will be pursued. Backed by this energetic management and the enviable reputation of the company's instruments, an exceedingly brisk spring business is expected.

The Central Electric company, Chicago, is meeting with its usual success in securing handsome contracts for interior conduit. During the last few weeks deals have been closed by the Central company for the furnishing throughout with interior conduit the following buildings: The Fair, Alexian Brothers' Hospital and the addition to the Royal Insurance building. It is, of course, unnecessary to add also that Okonite wires and cables are being used throughout in the above mentioned in-

stallations. These buildings are all in Chicago, and the placing of these large contracts with the Central company is another evidence of the way the friends of the company appreciate its prompt and efficient service.

It is perhaps needless to say that the Central Electric company in these days of close competition is feeling the good effects of its long years of straight, square dealing with the trade. Carrying as it does, a stock which is said to be the largest under one roof of any strictly supply house in the world, it is in a position with its highly experienced force to fill orders not only accurately, but with remarkable promptness.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued March 16, 1897.

578,707. Controlling Mechanism for Electric Motors. Frank R. Bacon, Milwaukee, Wis. Application filed December 21, 1896.

Contacts, back-stops and an electromagnet of a rheostat, and a switch-lever pivotally connected to a pin on the rheostat are combined with a switch-arm independently pivoted on the pin and adapted to be held against the core of the magnet when the latter is energized, and a spring connected to the switch-arm, so as to always draw the arm away from the magnet when the latter is de-energized, irrespective of the position of the switch-lever.

578,710. Storage Battery. Cornelius T. Barrett, Brooklyn, N. Y. Application filed May 4, 1896.

A cell consisting of a perforated plate of pumice stone in and upon which the peroxide or equivalent material is deposited, in combination with a confining envelope of lead having openings for the admission of the acidulated fluid.

578,716. Telegraph Fire Hose. Joseph Buchtel, Portland, Ore. Application filed April 14, 1896.

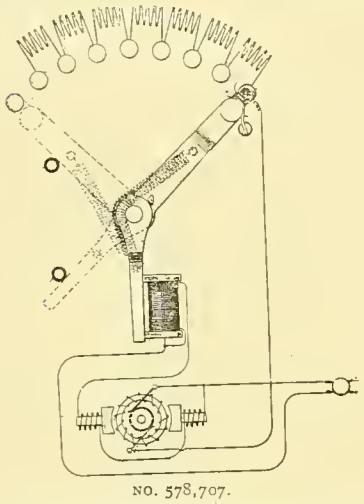
The nozzle is provided with a circuit closer, while an independent pipe-section connecting the ordinary hose and the telegraph hose carries a signal apparatus, a cut-off valve, a relieve-cock and a draw-cock.

578,750. Circuit Breaker. Herbert P. Kelly, Philadelphia, Pa. Application filed April 7, 1896.

A weakened conducting strip is included in the circuit of the magnet; a support for the strip and electro-magnetic means mechanically impinging on the support to break the strip are provided.

578,771. Cut-out and Agitator for Dust Transmitters for Telephones. Samuel B. Rawson, Elyria, Ohio. Application filed June 14, 1895.

The back-board has an insulated jointed arm connected thereto, the bell circuit having fingers in position to be engaged by the arm when swung upward, the transmitter



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having a finger in position to be engaged by the arm when swung downward, the battery circuit connected to the arm and transmitter, and the dust transmitter carried by the arm.

578,823. Charging Secondary Batteries. Isidor Kitsee, Philadelphia, Pa. Application filed November 2, 1895.

Incandescent lamps are connected in series as to each other, each pole of each lamp being connected to a conducting plate adapted to receive the terminal of one pole of a battery set.

578,825. Insulator. Henry H Luscomb, Hartford, Conn., and William F. D. Crane, Orange, N. J. Application filed October 24, 1896.

An insulator consisting of a body provided with means for attachment to a support, and having arms that project upwardly from opposite sides of the body near the top, fingers loosely connected with and movable between the arms, a part of the fingers being adapted to support the wire, and a part of the fingers being caused to embrace the wire by the action of the weight of the wire.

578,840. Railway Crossing Signal. Charles Selden, Baltimore, Md. Application filed February 11, 1897.

The claim: The combination of a railroad crossing signal adapted to be set from either side of the crossing, and provided with resetting devices for throwing it out of action at or about the time the train reaches the crossing, of a supplemental circuit and circuit closer operated by the train for keeping the signal temporarily in action while the train is passing said signal.

578,848. Trolley Repair Wagon. William B. Woods, Wheeling, W. Va. Application filed November 3, 1896.

The vehicle comprises a front or carrier truck and an independent adjustable rear truck, a front ladder frame pivotally connected at the lower end to the front truck, a rear supporting frame detachably connected at the lower end to the rear truck, a supporting platform having pivotal connections with the upper ends of the ladder and rear supporting frame.

578,867 Electric Battery. Howard N. Farley, Warwick, N. Y. Application filed April 11, 1895.

This invention comprises a system of operating a plurality of independent electrical instruments consisting of a single battery cell having a single electro-negative element and a plurality of electro-positive elements, the electro-positive elements being grouped at spaced distances apart, and having no metallic contact within or exterior to the cell, a single conductor leading from the negative element and carrying a common connector, and a series of separate pairs of circuit wires, one of the wires of each pair connecting with an electro-positive element of the cell, and the other wire of the same pair connecting with the common connector.

578,893. Burglar Alarm. Martin P. McDermott, Auckland, New Zealand. Application filed August 7, 1896. Patented in New Zealand December 3, 1895, and in New South Wales February 3, 1896.

The first claim is given: In combination, the two batteries, the alarm, the contacts to be closed by the unauthorized person, the magnet and the armature thereof, the line wire extending from one pole of the battery to the magnets, the circuit wires extending from the magnets to the contacts, and thence to the other pole of the battery, the contact and the wire leading therefrom to the battery to maintain the circuit complete when the armature is attracted by the magnet upon the closing of the contacts, the circuit wires leading from the battery, said circuit including the contact, the armature and the alarms, and a switch controlling the circuit of the battery, whereby both circuits may be broken at one operation by de-energizing the magnets.

578,939. Electric Carrier Apparatus. Harry M. Neer, Springfield, Ohio. Application filed July 25, 1896.

A carrier track and working conductors and sub-stations are arranged along the line of the track, with stationary auxiliary conductors adjacent to and parallel with the working conductors, and motors at the sub-stations adapted to be thrown in circuit with the auxiliary conductors, a traveling car on the track, and means on the car for connecting the auxiliary conductors with the working conductors.

578,954. Electrical Controlling Apparatus. Burton C. Van Emon, San Francisco, Cal. Application filed May 22, 1896.

A triple oscillating reversing switch mounted and turning on an axis with a series of parallel contacts at both sides, two solenoids to move the switch, and a spring or springs to disengage and hold the same out of contact.

578,976. Electric Clock Setting Mechanism. Charles M. Crook, Elgin, Ill. Application filed January 11, 1897.

There are an electro-magnet mounted on the clock frame, an armature for the magnet and a lever connected thereto and actuated by the movement of the armature toward and from the magnet poles, the lever having a pin or projection which, in the movement of the lever, is protruded through the plane of a rotation of a wheel in the train, and moved laterally after such protrusion to encounter a spoke or web of the wheel and rotate the same.

578,981. Lightning Arrester. Walter K. Freeman, Fort Wayne, Ind. Application filed July 5, 1895.

One claim is given: In a lightning arrester, the combination with the bracket or support, and the pendulous or movable electrode, of the fixed electrode, an insulator for said electrode mounted in the bracket, a series of washers with interposed disks of insulation surrounding the fixed electrode, a core carried by the bracket and projecting at one side of the fixed electrode, and a circuit connection coiled about the core and connected with the bottom washer.

578,992. Multiplex Telephony. Silas W. Holman, Boston, Mass. Application filed May 31, 1893.

As an equalizer for two undulatory currents flowing in multiple through two conductors, a double-wound impedance coil is provided, consisting of a magnetic core with two wires wound about each portion of it in opposite directions regarding currents which flow through the two windings in multiple, one of the windings being connected to each of the conductors.

578,997. Repeater. Charles W. Leiser, Carlinville, Ill. Application filed April 1, 1896.

Two relays are provided with armature levers, each having two spring contacts, two stationary contact points for each armature lever, two batteries connected with the main lines and with the forward stationary contacts of the relays, and the electrical connections, whereby signals made on one line will be repeated on the other line.

579,003. Telephone Transmitter. William J. Moore, Elmer, Mich. Application filed May 25, 1896.

Included in this arrangement are a solid part having an annular funnel-shaped hole extending inwardly into the solid material, and having an annular hole intersecting the funnel-shaped hole and extending to a diaphragm, a diaphragm resting on a ring of metal on a ledge of an annular enlargement of the intersecting hole and the ring of metal, granular carbon on the diaphragm, solid carbon resting against the granular carbon, a cap covering and securing the diaphragm, granular carbon and solid carbon to the solid part, a binding post on the cap connecting the solid carbon to a source of electricity, and means for electrically connecting the metal ring and means for pivoting the transmitter thus formed.

579,012. Dynamo-electric Machine. Gustave A. Scheeffer, Peoria, Ill. Application filed April 30, 1892.

In a dynamo-electric machine of the inductor type the combination is described of a shaft, a core, a pair of field magnet coils surrounding the core, an extension for the core between the two field magnet coils, a single set of armature cores connected to the extension and lying parallel to the shaft arranged in a circle, armature coils on the cores, and a pair of inductors in the shape of star disks, one at each end of the machine, capable of rotation relatively to the armature coils, closing the magnetic circuit between the central core and the armature cores.

579,024. Electric Elevator. Samuel D. Strohm, Philadelphia, Pa. Application filed April 4, 1896.

An electric motor is provided for operating the elevator, a switch controlling the circuit of the motor, a solenoid or magnet for operating the switch, a safety circuit including the solenoid or magnet, and a series of closers or breakers in the safety circuit controlled by the landing door.

579,028. Controller for Dynamo-electric Machines. Clinton E. Woods, Chicago, Ill. Application filed January 15, 1896.

A device is described, comprising a rotatable shaft having a cylinder rigidly connected therewith, the cylinder provided with a series of separated contacts, a series of brushes opposed to the contacts, an operating handle connected with the shaft, a movable part associated with the cylinder and connected with a brake associated with the dynamo-electric machine, and a connection between the contact cylinder and the movable part associated therewith, whereby the cylinder is automatically moved to its normal open circuit position when the brake is applied.

579,032. Electric Arc Lamp. Thomas E. Adams, Cleveland, Ohio Application filed October 1, 1896.

There is the combination with a magnet, a pivoted armature and an air-pot, of an arm projecting from the magnet and serving as a stop for the armature and a support for the air-pot.

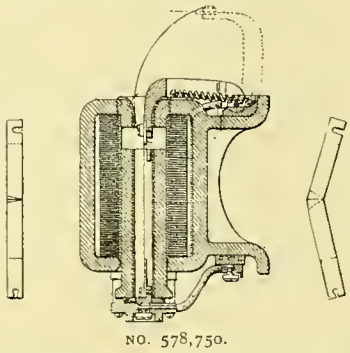
579,036. Telephone Switchboard Plug. Frank E. Bossong, Watseka, Ill. Application filed September 16, 1896.

The plug is wired to connect two subscribers' lines with means for cutting the calling subscriber and signaling current generator alternately into circuit with the second subscriber, and means for maintaining the central operator's telephone set constantly in circuit with the second subscriber during such alteration.

579,051. Means for Protecting Electric Machines from Heat. Jonathan P. B. Fiske, Alliance, Ohio. Application filed January 12, 1895.

The housing inclosing the electric machine has openings in the ends, with a fan located in one of the openings, the fan being carried by the armature shaft of the electric machine.

579,059. Construction and Regulation of Electric Machines. Thomas H. Hicks, Detroit, Mich. Application filed February 23, 1895.



NO. 578,750.

The machine is provided with field magnets, each having polar lips, and a short-circuiting magnet is magnetically joined to only one polar lip of each field magnet.

579,062. Electric Motor and Dynamo. William S. Horry, Gloucester City, N. J. Application filed June 15, 1892.

One claim is for means for producing rotating field poles, means for producing rotating armature poles in the same direction and speed as the field poles, means for rotating the armature in one direction for energizing the field and armature coils, and means for controlling the speed of rotation and reversing the direction of the field of force.

579,063. Regulator for Electric Motors. Rudolph M. Hunter, Philadelphia, Pa. Application filed May 22, 1894.

The combination is claimed of an electric circuit and power motor arranged in the circuit, and a counter-electromotive force regulator wholly independent of the field of the power motor and arranged in a shunt circuit about the entire power motor.

579,075. Electrical Call and Call Answering Apparatus. Edward H. Owen, Charles N. Williams and Fred H. Donaldson, Garvanza, Cal. Application filed September 14, 1896.

One claim is given: The combination in an electrical call and call-answering apparatus of a plurality of electro magnets, each having projecting pole-pieces, an armature pivoted at its corner portions directly to and swinging in the space between the two projecting pole-pieces of each magnet, a sign or visual signal device which is moved in a circular path by the motion of the armature between the pole-pieces of each magnet, a switchboard having a plurality of contact-pieces and a plurality of push-buttons, a switch-lever movable into engagement with any one of said contact-pieces, an audible signal electrically connected with said switch-lever, an electric generator, an electric circuit including the electro magnets, the switch-lever, the contact-pieces, the push-buttons and the audible signal, and a device remote from the visual signal devices for making and breaking the circuit.

579,079. Electricity Meter. August Raps, Berlin, Germany. Application filed July 25, 1896.

This device consists of a suitable direct-reading electrical measuring instrument, an oscillating balance and a registering wheel, all the parts being concentrically pivoted, means for registering the revolutions of the wheel, and means for coupling the balance with the wheel at every oscillation at the points indicated by the deflections of the needle of the measuring instrument.

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Electrical Bureau of the National Board of Fire Underwriters.

It will probably be a revelation to many central station men, especially those in the smaller towns and in out-of-the-way places, to learn that there is a thoroughly organized and fully equipped laboratory in Chicago supported by the insurance interests for the purpose of investigating the relative merits of apparatus and supplies used in electrical construction that have a bearing upon the fire hazard. Manufacturers and construction men in the larger cities are familiar with the work of this institution, which is known as the Electrical Bureau of the National Board of Fire Underwriters; and it is believed that a more intimate knowledge on the part of managers of small central stations will remove much of the prejudice that still exists against the so-called interference of the insurance people in electrical matters. The illustrations presented herewith show some views taken in the offices and laboratory of the bureau at No. 157 La Salle street, this city. The pictures presented on this page show several glimpses of the laboratory proper, the principal feature (Fig. 1) being the corner containing the rotary converter and motor for testing abrasive qualities of wires. Figs. 2 and 3 are also views of the laboratory. Interesting features of the equipment are shown in Figs. 4 and 5 on page 186. The former is a picture of a gasometer and oven for securing temperatures up to 400° Fahrenheit. The latter illustrates a marble and plate glass switchboard for controlling potentials up to 40,000 volts. The electrician's office and the assistant electrician's quarters are shown in Figs. 6 and 7.

Fig. 1. Corner in laboratory showing rotary converter and motor for testing abrasive qualities of wires.
Fig. 2. North end of laboratory.
Fig. 3. Entrance to laboratory.
ELECTRICAL BUREAU OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

The work of this bureau consists in the compilation and distribution of accounts of fires caused by electricity throughout the United States and in the operation of an electrical laboratory where tests of all electrical devices and materials on the market are carried on. Reports of these tests, together with the results obtained, are printed and furnished to the electrical inspection departments throughout the country and to architects and electrical engineers interested, and, of course, to the manufacturer of the especial device or material reported on. In addition, pamphlets are issued giving information on electrical topics of especial interest to insurance companies, and inspections of the electrical conditions of various cities and towns and of many individual plants are made throughout 20 central western states and territories, including Chicago and Cook county.

This bureau has been in active operation as at present organized for only a year and a half, but it has already accomplished a sufficient amount of good in raising standards of electrical construction to warrant great expectations for its future usefulness.

It has gathered and printed detailed and specific accounts of over 1,500 electrical fires and burnouts, which, together with illustrated supplements, have been distributed generally throughout the country to electric lighting and manufacturing companies, local inspection departments, engineers and architects. As supplemental to the code of rules, these have proved of great assistance in showing the necessity of careful and competent electrical construction.

In the laboratory work especial attention has been paid to apparent and consequential defects in devices found on the market, with a view to securing necessary improvements. Switches and cut-outs, wires, cords, hangerboards, insulating joints for fixtures, bushings and all the commoner forms of fittings have been tested under the most severe conditions they would be likely to meet with in practice, and the results obtained have been given wide publication. Models of new devices have been examined with a view to increasing their efficiency before putting them on the market, and thus far

a total of over 700 materials has been thoroughly tested, experiments continuing on some of them for periods of a month or more.

To-day this bureau has a fairly complete record of the merits and defects of all electrical appliances whose use has any bearing on the fire hazard. On the more common forms of materials, such as insulated wires and insulating materials, periodical tests are to be carried on with samples secured in the open market. It is expected to eventually maintain a rigid standard for such materials by this means.

In the experimental work it has, of course, been necessary to devise standard test specifications for comparing different devices intended for the same use, and in this, as well as in other points concerning which dispute might arise, the leading electrical engineers throughout the country have been consulted and their advice followed. It is certainly a welcome sign for the electrical interests to consider that the officers of insurance companies who control the executive management of this bureau do not depend upon any one man or set of men for rulings which may seriously affect either their own or the electrical interests, but in all cases requiring such attention are careful to obtain through the bureau the opinions of the leading experts in each especial branch of electrical work best fitted to pass judgment before reaching a decision.

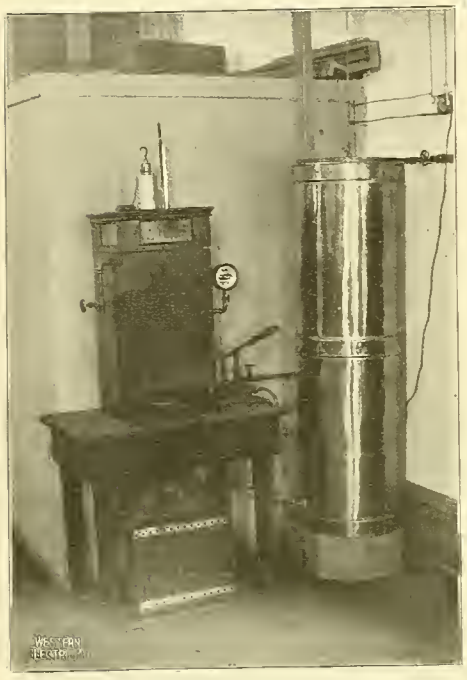

Fig. 4. Gasometer and oven for securing temperatures up to 400 Fahrenheit.

Fig. 7. Assistant Electrician's quarters.

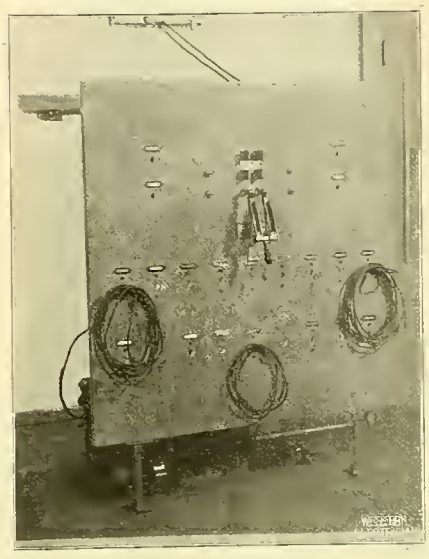

Fig. 5. Marble and plate glass switchboard for controlling potentials up to 40,000 volts.

Fig. 6. Electrician's office.

ELECTRICAL BUREAU OF THE NATIONAL BOARD OF FIRE UNDERWRITERS.

In some cases opinions secured in this manner have been published in full, as in the pamphlets which have been issued on "Electrolytic Deterioration of Water Pipes" and "The Operation of Lamps or Motors by Current Supplied from Trolley Wires."

As long as this policy is pursued, the success of the work and its support by the electrical fraternity seem assured.

The Consolidated Traction company of Pittsburg will begin the erection before long of a large power plant, which, with equipment, is expected to cost upward of $500,000. The plant will be located on a site owned by the corporation, fronting on the Allegheny River. The contracts are expected to be let at an early date.

Design and Construction of Electric Power Plants.[1]

By Bion J. Arnold, M. S.

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Part I.

Possible Sources of Energy.

Introductory.—In presenting these lectures I shall not attempt to enter into an exhaustive treatment of the theory of each subject, for the reason that each one is of sufficient importance to require much more time than is at our disposal, but it is my desire to give under each subject certain theoretical laws upon which it depends, and sufficient elaboration thereon to help us to get them well before us, while showing their application in practice, assuming, as I do, that you have all received from your instructors more or less of the theory of the subject, and that further investigation will be made by you. With this understanding I present these lectures from the point of view of one who is engaged in putting into practical application the theoretical principles involved in the design and construction of electric power stations, and it will be my aim to make my statements and calculations as definite as practicable.

The central electric station is to be regarded as a manufacturing establisbment in which the product is electrical energy, produced and measured on a large scale. It is the province of these lectures to investigate briefly all of the present known available sources of energy, in order that their relative values may be analyzed, and to deal with the practical problems of the most economical methods of transferring this energy into electrical energy ready for distribution.

The basis of all calculations upon the efficiency of any method producing electrical energy is necessarily the principle of the conservation of energy, stated by Maxwell as follows: "The total energy of any material system is a quantity which can neither be increased nor diminished by any action between the parts of the system, though it may be transformed into any of the forms of which energy is susceptible." That is, in any system energy cannot be created; neither can it be destroyed. We may take a natural source of energy and by suitable agencies change that energy from one form to another. In the boiler the heat energy of chemical combination of carbon and oxygen is transferred to the water of the boiler, thence to the steam engine, where this energy is changed into mechanical motion, which, when used in driving the generator, gives electrical energy. By means of suitable devices this electrical energy can be changed into energy of heat, light, mechanical power and magnetism.

But in every transformation less useful energy is available at the end of the operation than at the beginning of the process. To the statement of the law of conservation of energy should be added the further statement that "all energy tends toward the form of uniformly diffused heat." And since, by the second law of thermo-dynamics, heat can be made to do work only by the transfer of heat from a hotter body to a colder one, uniformly diffused heat is energy in an unavailable form. Hence in any system for the conversion of energy from one form to another the available energy constantly becomes less and less.

In any isolated system the amount of energy available for any useful purpose, divided by the amount of energy of the natural source, is called the efficiency of the system. As in each transformation the amount of available energy becomes proportionally less, in general terms, that system which contains the least number of translating devices will be the most efficient.

It is the object of the electric power station to produce electrical energy at the terminals of the switchboard, ready for distribution, at the least possible cost. This involves not only a consideration of the efficiency of the system considered as a whole (from source to output), but also includes the problem of first cost of the natural source and the entire cost of transforming it into available form. As in the manufacture of every product, the production of electrical energy depends upon the cost of the raw material and labor, the fixed annual charges of interest on capital and the fixed annual charges for depreciation of plant.

Sources of Energy.—A catalogue of all the possible sources of energy would probably be divided into the three following general heads:

1. *Energy of the Rotation of the Earth on Its Axis.*—The energy the of rotation of the earth on its axis may be taken advantage of by using the power of the tides. This may be easily done by storing water in reservoirs at high tide, allowing it to escape through a turbine at low tide, and thus operate a dynamo. Such a source of power is available at the seacoast only, and then only at places having a considerable rise in the tide. Some electric storage system would be necessary, as the tides change twice daily at varying times during the day throughout the year. This source of energy will probably never be used except in certain localities for small amounts of power.

2. *Internal Heat of the Earth.*—The internal heat of the earth is a possible source of energy of almost unlimited quantity, although little use has ever been made of it. It is perfectly possible, however, to tap the interior of the earth by suitable means and use the heat obtained in any of the usual ways familiary adopted for the use of heat of combustion of ordinary fuel, although it has never been put into practice, and probably never will be, owing to the expense involved in drilling and to the unmanageability of the well of heat, if successfully constructed.

3. *Heat of the Sun.*—All the energy not derived from the two former sources is obtained from the heat of the sun, which is an exhaustless reservoir of enormous proportions. It has been shown that the total heat received per annum from the sun by the earth is equivalent to the energy that would be produced by the combustion of a layer of coal eight inches thick covering the entire surface of the globe. The sun's rays have been focused by suitable mirrors, and engines of very limited power have been operated by the resulting heat directly, but of course this source is only available "while the sun shines," and would be very unsatisfactory for practical use; but the heat radiated from the sun is the origin of the energy of all the following natural sources. This principal source of energy is subdivided into the following:

Animal Power.—It is well known that the thermal efficiency of an animal is greater than that of a steam engine, for it is fairly well established that about one-fifth to one-sixth of the energy of the food consumed by man or the domestic animals can be regained for useful work. Horses might be used to advantage to work a treadmill and thence drive a dynamo, and we might reasonably expect to obtain enough power to light 10 ordinary 16 candle power incandescent lamps from each horse. A man operating a generator by means of a crank could be expected to keep two lamps lighted continuously for some time, but it is easily seen that these two sources of power are small and would be impracticable on a large scale.

Water Power.—Water wheels of various forms are, next to the steam engine, the most important prime movers for driving dynamos, and the development of water powers and the problems of the transmission of their power have been occupying the attention of engineers to a considerable degree for some years past. A list recently compiled by Dr. Louis Duncan, and published in the *Electrical World*, October 17, 1896, shows that there are in successful operation at the present time 27 plants, with a capacity of nearly 33,000 horse power, transmitting current from two to 20 miles, which will show the importance of this branch of engineering. Beside these plants, there are innumerable installations for the operation of isolated and city lighting plants using small water powers, and a few operating electric railroads, a list of which is given in the *Electrical World* of March 6, 1897.

There are a few inherent disadvantages in the use of water power of which might be mentioned: Difficulty of regulation on variable load; unreliability of supply, especially during summer months; too great a supply during flood periods; the cost of maintenance of expen

1. Lectures delivered before the Department of Electrical and Steam Engineering, University of Nebraska, March 15-19, 1897.

sive dams, reservoirs and raceways; and the necessity, in many instances, of providing an auxiliary steam plant to carry the load in times of failure of water supply, or of break down of the water wheels.

The advisability of utilizing a small water power for the production of electrical energy is always questionable, for the reason that its use is subject to the above objections, and is further dependent, first, upon the cost of fuel at the point at which the power is required, and second, upon the cost of improving the water power and constructing a suitable transmission line to carry energy from the water power to the point of utilization of the energy. In many cases it will be found cheaper to build a plant and produce the power by steam than to utilize the water power, owing to the fact that the interest on the investment necessary to make the water power available will be greater per annum than the cost of fuel and the interest on the money invested in the steam plant.

Wave Motors.—The ceaseless and unlimited power of the waves and of the ocean swells has always appealed to man as a source of power, but the successful wave motor is yet to be produced. Expensive experiments have been carried on from time to time, but the efforts have usually resulted in a collection of wrecked apparatus. This source of power would necessarily be very unsteady, and would require the adoption of some system of storing power in connection with it. At the present time an extensive experiment is being carried on at Capitola, near Santa Cruz, Cal., which is being watched with considerable interest by mechanical engineers. In this motor two sets of vanes or paddle-wheels swing with the surge of the waves, and from the extremities of each chains fitted to sprocket wheels impart rotation to a shaft carrying a large fly-wheel. The motor is expected to develop at least 200 horse power, which it is proposed to utilize with compressed air. A description of this machine is given in detail in the *Street Railway Review*, March 15, 1896. (See "Wave Motor Tested," WESTERN ELECTRICIAN, March 13, 1897.)

This method of producing power, if it ever becomes

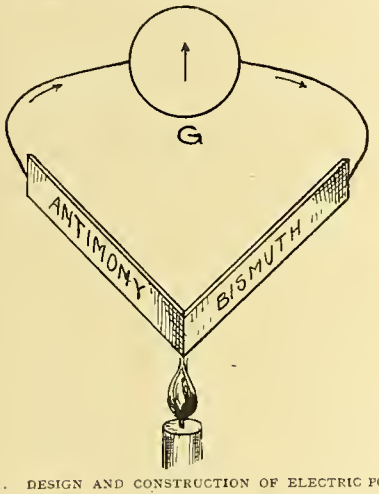


FIG. 1. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—SIMPLEST FORM OF THERMO-ELECTRIC GENERATOR.

practical, is of course only available on the shores of large bodies of water and cannot therefore be considered a practical method of obtaining power for universal use.

Wind Power.—The use of a windmill to operate a dynamo has the advantage that the energy itself costs nothing, the entire expense of production being that of interest and depreciation on the plant and the expense of attendance. A plant for the production of any considerable amount of electrical power, however, must be large. It will consist of a wind wheel (which, to develop 10 horse power in a wind of 16 miles per hour, must be 60 feet in diameter), driving a dynamo attached to its shaft in some suitable manner by means of belting or gearing. The unsteadiness and unreliability of the wind will require that some storage system be adopted. This will preferably be a storage battery. An automatic device, either mechanical or electrical, must be provided, so that when the wind dies down the batteries cannot discharge back into the dynamo. As the wind increases, and the speed of the wheel, and therefore of the generator, rises, the electromotive force of the dynamo would rise and therefore overcharge the batteries with an excessive current. This can be overcome by compounding the generator differentially; that is, so that the series coils oppose the shunt winding, the result being that upon an excess of speed the series coils tend to demagnetize the fields and thus keep the electromotive force at an approximate constant value.

There are a number of windmill plants in practical operation, the largest one probably being that of Charles F. Brush at Cleveland, Ohio. This installation operates an average load of 100 incandescent lamps, two arc lamps and a number of motors, with entire satisfaction.

The cost of electric lights by wind power has been estimated by George H. Morse, and varies from 12.57 cents per lamp-hour for a very small plant down to .55 cent per lamp-hour for a plant of 85 lamps capacity. The average cost of 16 candle power incandescent lamps in cities when delivered from central station lighting plants is from six-tenths to one cent per lamp hour. (See Abbott's "Electrical Transmission of Energy," p. 545).

Earth's Magnetism.—The variation of the earth's magnetism alters the number of lines of force passing through a circuit (a telegraph line, for instance), and produces in it disturbances known as "earth currents." These are very feeble and their strength varies. During violent magnetic storms they have been known to attain a strength of 40 milliamperes on some British lines of telegraph. When we stop to consider that the total intensity of the earth's magnetism is less than .5 of a dyne-unit (that force which, acting on one gramme for one second, imparts a velocity of one centimeter), and that it takes more than 445,000 dyne-units to equal a pound of force, we will readily see that the amount of energy available from this source is very small. The small intensity of the earth's magnetism makes it impracticable to construct a generator of sufficient size to produce electrical currents of commercial importance by this method.

An ingenious mechanism, a Gramme ring rotating under the influence of the earth's magnetism, was recently exhibited (September, 1896) in Liverpool, by J. A. Fleming, F. R. S., but can only at present be regarded as a scientific curiosity.

A further discussion of this subject can be found in S. P. Thompson's "Electricity and Magnetism," articles 71, 161, 155, and in an article published in *Electricity*, October 14, 1896, by J. A Fleming.

Primary Batteries.—Primary batteries are examples of the simplest and most direct methods of producing electrical energy, and for small work have been found very useful. Their usefulness, however, is very much limited and probably always will be, on account of their small efficiency of conversion, which may be placed at about 1.3 per cent. The best results obtained have been in those batteries in which zinc and sulphuric acid are the acting substances, and the lowest figure for fuel consumption for this form of galvanic battery is one pound of zinc per horse power per hour. It is safe to say that in a galvanic battery fully 50 per cent. of the zinc is wasted in practice, so that a very fair estimate would be to allow two pounds of zinc per horse power per hour. At four cents per pound the zinc alone for the most efficient battery would cost eight cents per horse power per hour. To this expense must be added the cost of remelting, casting or rolling, amalgamating and properly connecting in the cell, all of which processes will entail an additional loss of material. Then there is the cost of the acid to be taken into account, which will bring the cost of material in the very cheapest form of primary battery up to at least 18 cents per horse power hour. If we add to this a fair estimate for interest, depreciation and attendance, we may take 25 cents per horse power per hour as the best possible figure to be expected of a galvanic battery. This figure is over ten times the cost of a horse power hour produced by the agency of small steam engines, and over 100 times the cost of energy when produced by the largest and most efficient steam engines. Of course if we could use some other and more efficient reaction than between zinc and sulphuric acid, some gain might be secured, but nothing of this kind has yet been accomplished, and from what is known of the combining or thermal equivalents of the available elements, there is not much to be expected in this direction.

Direct Conversion of Chemical Energy into Electrical Energy.—This is the ideal method and one of the greatest problems to which the attention of the scientific world is at present turned, and owing to the fact that the attention of the public has been called to it so prominently of late, I have deemed it advisable to introduce into this lecture brief descriptions and illustrations of the different cells produced, so far as I have been able to find them recorded, in order that you may be in better position to analyze the descriptions that appear from time to time in the public press, if you have not already investigated this subject for yourselves.

Cells in which thermal energy is converted into electrical energy are divided into three principal types:[1]

1. Those in which the heat acts upon the materials submerged in the electrolyte, thereby causing fusion or decomposition.

2. Those in which the heat operates to set free chemical affinities, whereby the cell is caused to operate, the regeneration after exhaustion taking place at a lower temperature.

3. Known as thermo-chemical cells, and comprising all cells in which a difference of electrical potential is maintained by keeping the electrodes at different temperatures.

[Here the lecturer described the Becquerel cell, which produces electric currents by setting free electricity by the combustion of carbon or the oxidation of different metals by absorbing the substance of the electrolyte; Jablochkoff cells, consisting of cast-iron cells containing an electrolyte composed of melted soda or nitrate of potash; Brard "brick," made of carbon and a mixture of nitrate of potash and cinders, the two parts separated by a sheet of asbestos; Crum cell, having an electrolyte of fused black iron oxide in an iron receptacle; Edison cell, employing carbonaceous material for a soluble electrode; Langhans' cell, by which it is proposed to utilize, for the production of an electric current, the waste heat in the Jablochkoff and Becquerel types of cells; Fabinge and Farkas' cell, in which a solution of caustic soda, fused by means of some external source of heat, is placed in a small platinum vessel: and the Jacques, Bradley and Case cells of comparatively recent date.]

Thermo-chemical Cells.—In cells of this type a difference of potential is maintained between electrodes or plates of the same metal when immersed in an electrolyte consisting of a salt of the metals. The plate which has the highest temperature is usually the negative electrode, and the current passes from the hot to the cold plate, so that the cold plate corresponds to the zinc of the ordinary voltaic cell. Several types of this cell have been made by the different experimenters, but I can find no definite information regarding their efficiencies, and they can be passed over without further comment:

[The Case cell recently described before the New York Electrical society (see WESTERN ELECTRICIAN of March 6 and March 13, 1897), for producing electrical energy from carbon without heat, is reviewed.]

Thermal Methods of Producing Electrical Energy.—Under this head will be classed, in general, all methods in which the energy of the fuel is first liberated in the form of heat, and subsequently passed through one or more further transformations, finally appearing as electrical energy.

The efficiency of all methods for producing electricity in which the energy appears at any time in the form of heat is limited by the second law of thermo-dynamics. The greatest possible efficiency of any transformation of energy in which heat is involved is given by the formula

$$E = \frac{T_1 - T_2}{T_1}$$

where T_1 is the initial absolute temperature and T_2 is the final absolute temperature.

Thermal generators are capable of being subdivided into three main divisions, as follows:

Thermo-electric Generators.—This is one of the most attractive methods of generation of electric current, as it involves but one step between the combustion of wood, coal, gas or other fuel and the production of electrical energy. This method was discovered by Seebeck in 1822, his investigation proving that if two pieces of metal, one of antimony and the other of bismuth, are joined by soldering, a current of electricity will be set up between the two free ends if they are connected by a suitable conductor, and the joint of the two metals heated, as shown by Fig. 1, and that the current will be so maintained so long as the joint is kept at a higher temperature than the rest of the bars.

This property has since been found true of other metals, and the laws governing the action are given by Prof.

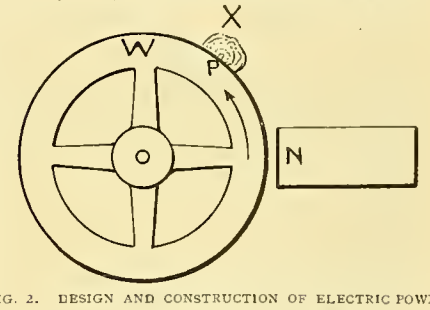


FIG. 2. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DEVICE ILLUSTRATING THERMO-MAGNETIC ACTION.

S. P. Thompson in "Electricity and Magnetism," as follows:

"First—The thermo-electromotive force is, for the same pair of metals, proportional (through limited ranges of temperature) to the excess of temperature of the junction over the rest of the circuit.

"Second—The total thermo-electromotive force in a circuit is the algebraic sum of all the separate thermo-electromotive forces in the various parts."

[Mr. Arnold shows how small is the proportion of heat transformed into electrical energy in the thermo-electric generator—less than one per cent. Cox's thermo-electric generator is considered at some length, and not unfavorably, as shown by the concluding sentence: "The fact that the generator is very simple, containing no revolving armature or other moving part, and that the process is very direct and perfectly safe, will in many cases more than outweigh the extremely low efficiency, and for isolated plants of not exceeding one or two horse power it bids fair to find a field awaiting it."]

Thermo-magnetic Generators.—The fact, first pointed out by Dr. William Gilbert, that iron and all other magnetic bodies lose their magnetism and power to transmit lines of force at high temperatures, is the basis upon which Gore (1868), Thomson and Houston (1878), McGee (1884), Schwedoff, Edison (1887) and Menges have pointed out the possibilities of constructing thermo-magnetic generators and motors.

Gore showed that a current could be generated by heating and cooling a magnet placed in "inductive proximity to a coil of wire."

The experiments of Thomson-Houston, McGee and Schwedoff amounted practically in showing that a disk or round coil of iron could be revolved by placing it upon a vertical axis and heating one edge by means of a Bunsen burner, or other suitable device, and bringing an electro or permanent magnet near to the disk at about 90 degrees from the heated portion.

In Fig. 2 if N is the permanent magnet and W the disk or wheel and X the flame, the disk W will rotate slowly in the direction indicated by the arrow if the disk is heated to about 400 degrees Centigrade at P, provided the disk is thin enough to cool partially during its revolution. The motion is very slow, but serves to illustrate the principle involved.

[Edison's pyromagnetic motor, an improvement upon this device, is described, and also Menges' machine, more completely worked out].

Iron loses its permeability at 785 degrees Centigrade,

1. See "The Voltaic Cell," by Park Benjamin, chapter XIII.

and as the theoretical temperature is controlled by the formula

$$E = \frac{T_1 - T_2}{T_1}$$

the efficiency of a generator of this class is limited. It is open to the same objection of heat loss as the thermo-electric class of generators. In fact, no practical apparatus of the character has ever been constructed.

Thermo-dynamic Generators.—Under this head are to be classed all processes in which energy liberated as heat is converted into kinetic energy of mechanical motion, and thence by means of a dynamo into electrical energy; and it has been subdivided under the four headings following:

Gas Engines.—In this class of engines the combustion which supplies the heat occurs within the closed cylinder, and they are therefore known as internal combustion engines. Theoretically the gas engine at the present time is the most promising prime-mover. In the first place the efficiency as derived from the formula

$$E = \frac{T_1 - T_2}{T_1}$$

may be very high. If the initial temperature (which determines the value of T_1) be that of combustion and the final temperature (which determines the value of T_2) be that of the atmosphere, the value of E may be over 80 per cent. Deduct from this the losses due to friction and to dissipation of heat, and there is still left a possible commercial efficiency of fully 40 per cent., or nearly four times the possible efficiency of the best steam engine as at present developed.

Gas engines have many other advantages beside that of comparatively high efficiency. They are free from smoke, dirt and ashes, which so necessarily accompany a steam engine. They can be operated by unskilled labor, and because a licensed engineer is not needed are especially suitable for small isolated plants. When a gas engine stops running the consumption of power ceases, and there is no waste of fuel to keep the fire "banked" as in a steam plant. The space occupied by a gas engine plant may be much less than that required for a steam plant, as no boiler room, stack and accessory equipment is required.

On the other hand, the gas engine itself costs from two to three times as much as a steam engine alone for the same output. This extra cost is due to the fact that the gas explodes as a rule at every other stroke of the engine, requiring, therefore, a much larger cylinder for a given capacity than in the case where the application of power is practically continuous. The cost of the extra large engine necessary is partly offset by the fact that no boiler is required, so that the total space occupied by the plant is less; but it is doubtful if the cost of a gas engine for large power would be less than a complete steam plant of equal capacity. If, beside the gas engine itself, a plant for producing the gas is considered, it would seem that the advantage of less space occupied by the gas engine plant would disappear.

Gas engines, moreover, are hard to start, and in large sizes many times require a small auxiliary engine which can be started by hand. The odor of the exausting gas is objectionable, and lubrication is extremely difficult. It is necessary to keep the cylinder cool by circulating water around a water jacket, and finally, gas engines have a disagreeable habit of stopping when slightly overloaded. The efficiency of a gas engine falls off very rapidly if the power required becomes less than its rated capacity; so they are entirely unsuitable to plants with a fluctuating load.

Gas engines as now used are of the explosive type; that is, a mixture of combustible gas and air is introduced into the cylinder and there ignited by a small gas-jet, an electric spark or an incandescent body. The high pressure resulting from the explosion acts upon the piston in the cylinder and causes it to move and develop power.

The record of the consumption of gas depends, of course, upon the calorific value of the gas. With ordinary illuminating gas it is well to allow about 20 cubic feet of gas per horse power hour, though results have been obtained showing only 17 and even 15 cubic feet.

Heavy fly-wheels are always used to overcome the unsteadiness which would naturally result from the infrequent explosions. A storage battery auxiliary in connection with a gas engine will remove the objection of extremely low efficiency on an underload by evening up the load line and by allowing the engine to be worked up to full capacity while in operation, the storage battery being relied upon to furnish light and power during periods of small demand.

Wherever the gas engine is used, especially in small powers, it seems to give eminent satisfaction, but its introduction for power plants seems to be much slower than its advantages and high efficiency would seem to warrant. This lack of progress in gas-engine development can be traced, to a great extent, to the high first cost which, as already mentioned, is two to three times that of a steam engine. When manufacturers finally perfect and simplify their engines, so that they can be made at somewhere near one-half the present price, it will not be unreasonable to suppose that many electric power plants will use gas engines. Until that time we shall probably continue to use our present much abused prime-mover, the steam engine.

Hot-air Engines.—When air forms the working substance, it receives heat from an external source, and hence an air engine is known as an external combustion engine. The temperature of the air is necessarily less than the temperature which is produced by combustion,

[*Continued on page 193.*]

Cable Testing.[1]

By George D. Hale.

As the unreliable and to a large measure experimental methods in electrical construction of the past are being rapidly replaced by more substantial scientific systems, so is the pole line giving way to the electrical cable wherever the change is feasible from a financial standpoint.

The demand for ever increasing reliability and high quality of service has long since settled this problem electrically, but financially it often remains an open question.

As in everything else, there are all kinds and grades of cables adapted to all classes of service and complying with widely differing specifications. The feeble telephone currents and the high potential circuits alike require a high resistance insulation, though for different reasons, and a most reliable construction of the line to secure the best results. For low potential systems it is considered unnecessary to have such high resistance insulation, as the loss would be immaterial and the element of danger would not be of any serious importance. Assuming that high grade cables are necessary for telephone systems at least, the questions arise:

How to manufacture such as will be suitable?

How to test the same during and immediately following the process of manufacture?

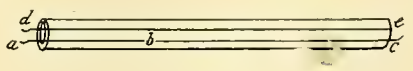


Fig. 1.

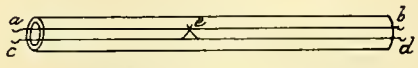


Fig. 2.

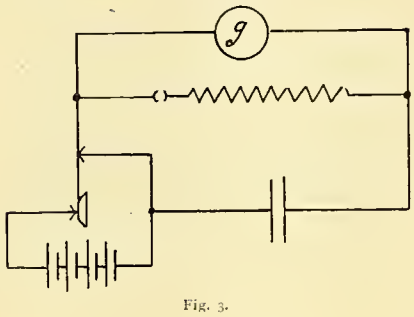


Fig. 3.

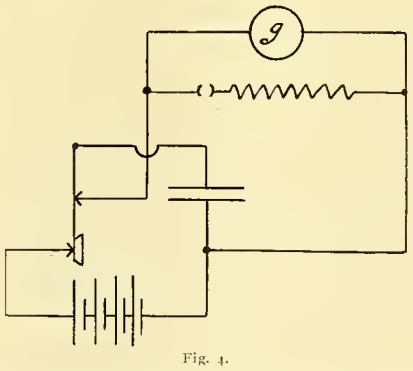


Fig. 4.

How to prevent their deterioration when laid?

How to locate trouble in them when its arises?

As regards the first, the manufacturers have solved this for us and have placed on the market the well-known lead-sheathed, paper-insulated, dry-core cable. For the benefit of some, a slight description of this cable might be in order. It consists of a bundle of separately insulated copper wires, varying in number from five to 200 pairs, the usual size of wire being No. 19. As ordinarily constructed, each wire is taped with a paper ribbon, the wires of a pair being wound spirally around each other, each concentric layer being wound on spirally, right and left hand alternately, the whole being wrapped with cotton yarn and enclosed in the lead pipe. By far the larger proportion of these cables are without any paraffine or other insulating compound, but are simply baked until free from moisture. The main advantages of this type of cable are their low electrostatic capacity and their high resistance insulation. Their weak point is that a small opening in the lead sheath practically ruins a cable in a few hours. Where a low capacity is not essential the cables are usually saturated with paraffine, so that in case of a hole being made in the sheath the entire section of the cable will not be rendered worthless. However, as paraffine absorbs moisture to some extent, the opening should be located and repaired as early as possible to prevent the loss of a considerable length of the cable.

Now, considering the second question as to factory tests, this will be divided into two parts—tests made during the process of manufacture and tests made immediately following the completion of the cable.

In the former the wires are simply tried with battery and bell to test for continuity and absence of crosses. In the case of a broken wire, as in Fig. 1, the capacity of each portion is measured as against the rest of the wires, and by direct proportion the distance from either end is determined. The capacity of $ab+bc$ should equal the capacity of the good wire de. The capacity of $ab+bc$: capacity of ab :: length of ac : length of ab. If the insulation is low a special method to be described later must be used. When two wires are crossed, the resistance of the wires is measured separately; also the resistances around the loops aec and bed are determined, corrections being made for the resistance of the cross and the distance from either end calculated as in Fig 2. The resistance of wire per foot, as measured in ab and cd is found to be, say, x ohm. Then the resistance of the loop $aec \div x$= twice the length from a to e. To check the work the resistance of loop bed may be measured.

The cables, having passed through the preliminary tests, go next to the drying ovens and then to the hydraulic lead presses, where their manufacture is completed. After cooling sufficiently, they are turned over to the cable testers, where the electrostatic capacity and insulation resistance of the wires are measured. The requirements usually specified demand an average

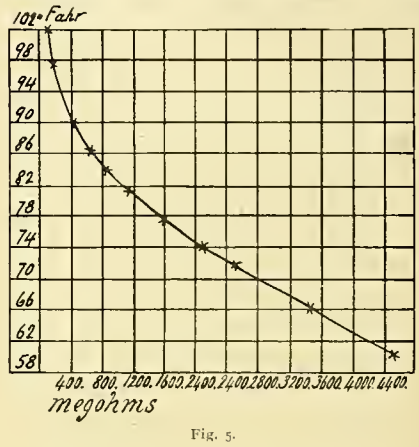
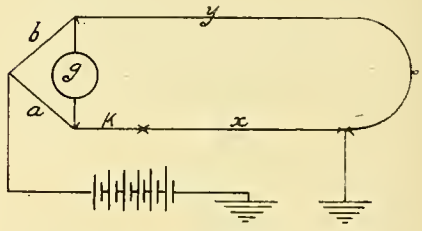


Fig. 5.



b and a = arms of bridge
K = variable arm
x and y = Portions of loop
$L = x + y$ or $y = L - x$

$$\frac{b}{a} = \frac{y}{K+x} \text{ or } \frac{b}{a} = \frac{L-x}{K+x}$$

$$\therefore x = \frac{aL - bK}{a+b}$$

Fig. 6.

CABLE TESTING.

capacity not exceeding .080, with no wires above .085 microfarad per mile. The insulation resistance must be at least 500 megohms per mile. In saturated cables the capacity varies between .1 and .3, depending upon the details of construction, and the insulation resistance ranges between 100 and 1,000 megohms per mile. The absolute capacity and insulation resistance of the wires vary from one of a microfarad up and from 500,000 megohms down, depending on the length and kind of cable, so very sensitive instruments must be used.

A large four-coil astatic needle Thomson galvanometer has been found to be suitable, and having a potential of 600 volts at command the insulation resistance constant is 528,000, while 2,000,000 can be obtained if desired. For capacity measurements the constant is 26,400, which is sufficiently high for all cables usually met with, however short.

The 600 volts is generated by a motor-dynamo obtaining current from a storage battery of 20 volts. A very steady voltage is thereby secured, so that the potential can be used in the testing circuits in the same manner as if the voltage was derived from a battery direct. The circuits used for capacity and resistance in the cable tests are shown in Fig. 3, and for capacity only in Fig. 4.

In charging dry-core cables with the 600 volts, it seems to make no difference in capacity readings how long they are in circuit, but the insulation resistance increases slightly with the time of charging. However, in saturated cables the longer the cables are charged the greater are the capacity and the insulation resistance, owing to the soaking in of the electricity and the polari-

1. Read before the Chicago Electrical association, March 19, 1897.

zation of the dielectric. Five seconds are sufficient for dry cables, while one minute is uniformly used in all saturated ones.

It is sometimes stated that the insulation resistance of a cable will not be the same when measured with different potentials, but it has been found that such is not the case. As long as the dielectric acts as a conductor only, there being no sparking through the paper, no change in the insulation resistance could be detected.

Heat increases the capacity and decreases the resistance to a slight extent in dry cables, but in saturated ones the variation is most pronounced. The curve, shown in Fig. 5. was plotted from experiments which illustrate this point. This curve was constructed from tests made on a paper-insulated, lead-sheathed electric light cable, having a No. 6 solid conductor surrounded by one-quarter inch thickness of paper saturated with resin oil. It was placed in a large tank of water heated very gradually, and was allowed to remain two or three hours at one temperature before a reading was taken, in order that the error should be as small as possible. The factory tests on all saturated cables made in the winter are, therefore, as a rule somewhat higher in resistance and lower in capacity than those tested in summer. This is due largely to the reason just mentioned, but the presence of moisture in the air during the summer also tends to lower the resistance to some extent, as the cable ends absorb some moisture from the air. Since a cable is nothing more nor less than a condenser of a small capacity, so anything which affects one may be expected to have its effect in the other. Hence, when the resistance of insulation drops for any reason the apacity increases.

In a 100 pair No. 19 wire dry-paper cable an increase of one thirty-second of an inch in diameter will decrease the capacity. about three-thousandths of a microfarad per mile. This increase does not apply to the pipe alone, but the whole cable is loosened to some extent. Another detail which increases the capacity of this style of cable is the paraffine which saturates the ends of the reel length. This is done to prevent the absorption of moisture by the paper, which is exceedingly dry, while the cable is being tested as well as when the splices are being made between reel lengths.

How to prevent deterioration of the cables after being laid is the next question. The ease with which the lead-sheathed cables may become punctured is their admitted weak point, and how to protect them from electrolysis and mechanical injury is difficult as well as expensive. Electrolysis is often prevented by coating the lead sheath with several layers of tape laid on with some insulating compound. This process has given good satisfaction in some places where the conduits are filled with water, having a corrosive action on the lead. Mechanical injury is usually avoided by placing the cable in strong conduits or in elevating them on poles.

As regards the tests of cables when laid, much which has been said concerning factory tests applies equally well here. However, the main differences lie in the decreased sensibility of the apparatus required and the new feature of hunting and locating trouble. The long lengths of cable mains have a high absolute capacity and a low insulation resistance, so the instruments need not be nearly so sensitive as in the usual factory tests. The greater part of the trouble in telephone mains can be traced to low insulation, usually located in splices or near perforations in the sheath. The old orthodox method of cut-and-try is often used; this consists in opening the line successively from splice to splice and locating the trouble in a certain length. However, this is only used when the insulation resistance is comparatively high, or when all the wires in the cable have the same resistance, which two conditions prevent the usual loop tests. Varley's loop test, which is employed to locate the place where a wire is grounded to a greater or less extent against the sheath, is illustrated in Fig. 6. Since the resistance of the ground introduces no error in the work, but simply makes the galvanometer less sensitive, this method may be very accurate when proper precautions are taken.

In an aerial cable line, about seven miles long, the location of a partial ground was found by this method where the resistance of the ground was over 300,000 ohms, while the best wire was only three megohms. When the contact of the grounded wire is variable, great care is necessary to avoid misleading results. When two wires are crossed with a high resistance at the point of contact, Varley's loop method may be used, considering one of the wires as the ground and using an extra wire for the clear side of the loop. Thus it may be seen that with proper instruments and a little care the location of any trouble usually met with is comparatively a simple matter.

New Book on Submarine Cables.

A work entitled "A Treatise on Submarine Telegraph Cables: Their History, Construction and Working," has been prepared by Charles Bright, C. E., F. R. S. E., and will be published by Crosby, Lockwood & Son, 7 Stationers' Hall Court, London, provided that a sufficient measure of support can be obtained beforehand. The size of the proposed book is super royal octavo, and it will contain about 600 pages, fully illustrated with drawings and diagrams specially prepared for it. The price to subscribers will be two guineas ($10.30), but after publication the price to non-subscribers will be three guineas.

Mr. Bright has been continuously occupied in submarine cable work for over 15 years, so that he is amply qualified from extended experience to deal with the subject from the practical point, while the papers of his father, the late Sir Charles Bright, have provided him with unequaled material for the historical section.

Mr. Bright's work contains a complete history of submarine telegraphy, treating the subject from the financial and political as well as from the technical side; it deals with the science and practice of cable laying and working in all their engineering and electrical details, including descriptions of the latest improvements in high speed machine transmission. The subject of insulation is dealt with exhaustively, and the methods of manufacture in producing gutta-percha and india-rubber covered cores are completely described. A valuable feature of the book, too, is the section devoted to patents, in which all master patents are described fully and categorically. The book is one, in short, that an electrical library will scarcely be complete without, while it will specially appeal to the specialist in telegraphy, telephony and insulated wires.

New Steel Arch Bridge for Trolley Line Across the Niagara Gorge.

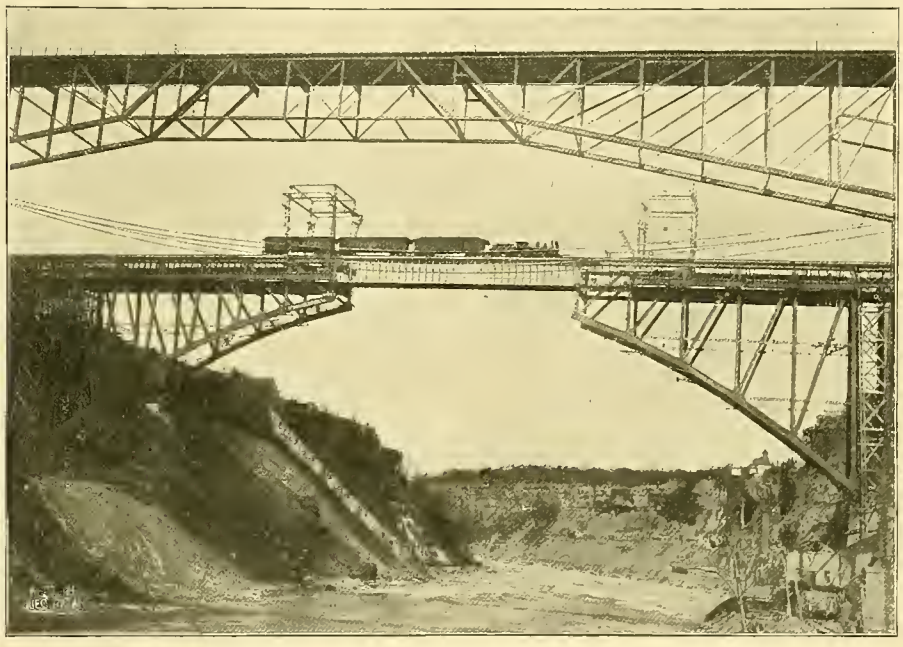
By Orrin E. Dunlap.

There is now in course of construction across the Niagara gorge at Niagara Falls a new steel arch bridge which will afford the first trolley car connection between the Dominion of Canada and the United States. The erection of the bridge is attracting much attention, not alone because of the dangerous nature of the locality, but also from the fact that is being built to replace the old railway suspension bridge and right on the site thereof. All who have ever traveled to or from Niagara over the Grand Trunk railway will recall the suspension bridge on which the crossing of the gorge was made at the whirlpool rapids. It is this structure that is to give way to the new arch, and the illustration in connection with this article well portrays how the arch is being built beneath and at the sides of the suspension bridge, and this while the latter is in constant use by railway trains, carriages and pedestrians. Of itself the erection of a great steel arch across such a chasm as the Niagara gorge is a difficult task, but to place it on the site of a bridge of a different pattern in constant service adds materially to the difficulties of the undertaking. It is a work that calls for no small amount of engineering ability. The engineer in charge is L. L. Buck, who is thoroughly familiar with the locality. The first bridge on this site was commenced in 1848 and completed in 1855. This structure was of wood, the towers being of stone. In 1880, under Mr. Buck's supervision, the superstructure was changed to steel, and in 1886 the stone towers were renewed in steel. All this was accomplished without any interruption to travel.

Preparatory to the erection of the new arch, great structures of false work were built out from the cliffs on each side of the river to a point where the abutments were located. One end of this false work is to be seen in the illustration. The work of placing the steel was started on both sides of the river, and day after day the structure has grown toward the center until within a few days now the two sections will meet over midstream and the arch proper be sprung. This stage is expected to be reached early in this month.

When it is completed the new arch will compare most favorably with the bridges of its class in this country or Europe. The arch will have a span of 550 feet between the end piers, and trussed spans 115 feet in length will connect it with the cliff on each side of the river. The main span is formed by an arch with horizontal upper chords. On the New York state side the bedplates of the arch rest on abutments built on the Clinton limestone. On the Canadian side of the river the abutments rest on a concrete foundation. On both sides of the river the abutments are situated about half way up the slope between the water's edge and the top of the high bank.

In order to provide facilities for steam and electric railways, carriages, etc., the arch will have two floors or decks. The upper floor will be devoted to steam railroad facilities and the lower floor to trolley tracks, carriageways, walks, etc. No other bridge across the gorge at Niagara has room for trolley tracks, and it is highly probable that the first trolley car to pass from the United States into the Dominion of Canada on its own wheels and by its own power will cross the grand new arch. The fact is that the electrical era has been a great incentive to the construction of the arch with trolley car facilities, for the possibilities of a belt line about the gorge, or at least a portion of it, are plainly recognized by the men interested in the trolley lines on both sides of the river, who would probably enjoy an exchange of business.



NEW STEEL ARCH BRIDGE FOR TROLLEY LINE ACROSS THE NIAGARA GORGE

The contract for the erection of the bridge is in the hands of the Pennsylvania Steel company, and, considering the difficult nature of the task, the season of the year and the dangerous point of operations, it has made most rapid headway, and this without a single life having been lost. While the arch will be sprung in April, the bridge will not be completed until June or July. It has been figured out that the arch will contain 5,560,000 pounds of steel plates and angles in the form of columns, plate girders, braces, etc.; 218,000 pounds of steel castings; 182,143 pounds of steel eye-bars and pins, and all of 30,000 pounds of wrought iron rods and turnbuckles. In its completed state the arch is expected to carry an exceedingly heavy load both on the upper and lower decks. The present railway suspension bridge will be taken down, and thus will disappear one of the oldest landmarks on the Niagara frontier.

The Italian ambassador to the United States has informed the State Department at Washington that an international exhibition will be held in Turin, Italy, in 1898. Exhibitors from all countries will be admitted to the special department of electricity, which will be divided into eleven classes, embracing everything pertaining to electrical theory and practice.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE professional agitator is a dangerous man in any community, no matter in what walk of life he may be found. His influence is pernicious. He is constantly stirring up strife, endeavoring to corrupt the public mind and inflame public anger against property, law and order, cultivating a spirit of discontent and inciting his followers to deeds of violence and disorder. He appeals to passion and prejudice against constituted authority and he attacks all that gives strength, security and moral stability to society. If he is honest in his belief that he can accomplish reforms by such methods he is all the more dangerous, as he may attempt to put his theories into practice and thereby do positive harm. Then he should be locked up in a mad-house. But there are probably few such agitators. There is abundant evidence that their preaching is for effect and that there is no greater danger than that they may secure political advancement through such practices. But there are despicable wretches who have been known to organize strikes, incite their followers to riot and bloodshed, and then betray them, or at least attempt to sell them out. An instance of this kind was revealed in Philadelphia last week, when the management of the Union Traction company exposed two labor leaders who had gained the confidence of their associates for the purpose of betraying them. What is to be said of such degraded creatures? And what of the poor deluded dupes who follow them blindly despite repeated warnings?

The growing importance of the electrical interests has attracted the attention of these agitators to this field. There are many organizations among street railway men, electric light men and construction men in all departments, and like all other organizations of their kind there are different classes. Some are formed for the purpose of improving the condition of the electrical workers who comprise the members, while others are seemingly devoted to the advancement and enrichment of a few professional agitators, like those exposed in Philadelphia last week. Altogether, it must be admitted that the labor question is assuming a serious aspect in electrical enterprises.

AN interesting story comes from a California town where, according to a local paper, nearly all the bells in the place have been on a spree for two days. "Whether it just happened so, or if the electricity in the air is the cause, is a question," says our informant. During a little thunder-storm to which the town was treated the big bell at the fire department would tap with every flash of lightning. Again, a bell that for twenty years had not struck the hour at the clock building attempted to revive memories of the past, and tolled off 11 solemn strokes. People who heard it thought the veteran clock had begun its rounds again, but they were disappointed. Still another incident is recorded: "The chimes at the Fithian tower continued to ring after the hour had struck, and, as in the case of the town clock, no reason can be given."

ALTHOUGH convicts in many state prisons are permitted to raise beards as a reward for good behavior, the employes of a street railway company at Reading, Pa., are forbidden to wear either mustache or beard. It is generally conceded that street railway corporations have the right to select a suitable uniform for employes, and a regulation of this sort is entirely consistent, as these positions are in a sense in the public service. But the arbitrary action of the petty tyrant at Reading is not of this kind. It is highly offensive to the honest, self-respecting and intelligent workingmen at whom it is directed. Doubtless it will be resented by the indignant employes, and public sentiment will support their protest. Only one course is open for the company if it desires to retain the respect of the community. The offensive order should be repudiated publicly and the officer responsible for it should be instantly dismissed.

IN securing the exclusive right to the serial publication of the lectures delivered last month at the University of Nebraska by Bion J. Arnold, the WESTERN ELECTRICIAN feels that it is providing for its readers during the next three months a feature of assured excellence. As a student, Mr. Arnold is close, careful, persistent, yet enthusiastic withal; as an engineer he is practical, cautious, yet quick to adapt himself to existing conditions, and eager to secure the best result without dogmatic adhesion to any pet theory. He seems to balance well theory and practice and has been successful in accomplishment. Devoting especial attention to power station work, he is well qualified to speak on the "Design and Construction of Electric Power Plants," which is the subject of his series of lectures

The first lecture, which appears in this issue, somewhat abridged, shows with what thoroughness Mr. Arnold approaches his subject. It is general and preliminary, surveying all possible sources of energy that may serve for use in the production of electricity. The energy of the rotation of the earth and the internal heat of the earth are mentioned, but it is to the heat of the sun that we must ascribe all practical work. Under this head animal power, water power and the force of wind and wave are considered. The earth's magnetism and primary batteries are touched upon, and then considerable attention is paid to that fascinating subject—the direct conversion of chemical energy into electrical energy. This is considered under three heads, and then the thermal methods of producing electrical energy are taken up. In this class the sub-divisions are thermo-electric generators, thermo-magnetic generators and thermo-dynamic generators. It is under the last named heading, of course, that the lecturer considers gas engines, hot-air engines, and, last of all, the steam engine. Here, then, we arrive, by a process of selection, at the source of energy utilized in nine-tenths of the power plants of the country, and which, in its various transformations, modifications and applications, will be considered in the succeeding lectures.

The next lecture relates to the relative losses in the different parts of the power station and to the cost of producing power. It will be of interest and value to all interested in the production and application of electricity, either theoretically or practically; and the same may be said with confidence of all the lectures to follow.

INSURANCE interests as related to electrical construction work are identical with those of owners of central stations and isolated plants, but very often a different view of the situation is taken. The insurance men in many localities have come to look upon the electrical industry with distrust and suspicion, and on the part of the electrical interests there is a tendency to regard the insurance people as a class of busybodies, given to meddling where they are wholly incompetent to judge of the merits of the situation, even if there was an inclination on their part to deal fairly, which is denied by many electrical men. Thus, it will be seen, two important interests which have much in common and which should be working in harmony for the betterment of conditions, and thereby raising standards of practice, have greatly retarded progress because of their attitude toward each other. Every candid observer must admit that there has been cause for complaint on both sides. In the early days there was no uniformity of practice and much of the best construction work that was then done would not be tolerated now. As a result there were accidents and fires, and it soon became the custom to attribute every fire in a building containing electric wires to this new agent, which, it must be admitted, was imperfectly understood even by those who were handling it. The underwriters, unfortunately, resorted to very arbitrary methods and enacted rules that were in many particulars absurd and often extremely burdensome. Compliance with these regulations was exacted as a condition of securing insurance. It was but natural that men with such scant information at their command as the underwriters had upon the questions of electrical construction which they presumed to pass upon, should make mistakes and that some of the blunders should be serious and far-reaching. Their lack of technical knowledge several times betrayed them into taking action that more extensive experience and riper judgment would have prevented. Probably the greatest blunder, and certainly the one that did more to bring their decisions into general contempt, was their action upon underwriters' wire. They have not yet lived down the effect of that decision. But it would be unjust to-day to measure the influence of the underwriters upon the electrical interests by any such standard. The restrictions of the insurance companies have doubtless stimulated the electrical interests and made improvements imperative, while otherwise they might have passed through a much slower process of development. A more intimate relationship between the electrical and insurance people has naturally modified the opinions of both, and a better understanding exists to-day because of their experience. Yet there is much to be done in the way of removing prejudice and overcoming the feeling of distrust that was handed down from the early days of the industry. Unquestionably the best means of attaining this most desirable end is by harmonious action and by a thorough appreciation of the efforts of both parties to improve existing conditions. The underwriters, on their part, have established in Chicago a splendidly equipped laboratory for the purpose of making tests and experiments with electrical apparatus, fixtures, wires and general supplies. It is in charge of a competent electrician, and the work thus far accomplished is satisfactory to the trade and creditable to the bureau. An idea of the scope of the work which it has undertaken may be gained by perusal of the leading article in this number. It is believed that when the electrical interests generally recognize what has already been accomplished in this line, the efforts that are now being put forth and the policy of the underwriters, they will readily co-operate and work in harmony for the best interests of the industry.

Extravagance in City Electrical Department.

Further examination of the records of the city electrical department by a representative of the *Chicago Record* exposes a condition of affairs that will probably astonish the taxpayers of the city. The story of this investigation and the disclosures is given in the *Record* of March 29th and is here reproduced:

Every engine house in the Chicago Fire Department has an alarm outfit known as the "little joker" system. The system was invented and patented by Prof. John P. Barrett, superintendent of the city telegraph department. Prof. Barrett has charge of the purchase of these outfits as they are needed in the service. He buys them from the Police Telephone & Signal company, a concern which he organized and controlled for many years, and which is now western agent for the Gamewell Fire Alarm Telegraph company of New York.

The city pays the Police Telephone & Signal company $325 for each engine-house joker outfit. For a smaller outfit, used in the houses of Marshal Swenie and the chiefs of battalions, it pays $125. This company, not having a manufactory in this city, orders the instruments in the outfit from the Western Electric company. If Prof. Barrett dealt directly with the manufacturing company, according to its published price-lists, he could secure similar instruments, in their most expensive form, for a total cost of $83.66 for the engine-house outfit, and $37.90 for the marshal's outfit.

The Police Telephone & Signal company is the concern which Prof. Barrett recently favored in letting a contract for 75 fire-alarm boxes. He recommended the purchase of their boxes at a cost of $100 each, and rejected similar boxes, offered by the United States Fire & Police Telegraph company for $45 each. An expert commission of electricians examined two sample boxes for the *Record* and pronounced them equal in point of merit.

The favor shown this company by Prof. Barrett in the purchase of joker outfits, fire and police boxes, and other supplies for the fire and police alarm service, gave it the largest account of any one firm with the department of city telegraph for the year 1896. Last year the city paid its vouchers to the amount of $13,030.25. A review of the electrical supply market during that period shows that similar outfits and supplies of the best quality could have been purchased by Prof. Barrett for $6,712.75. In 1895 vouchers were paid amounting to $14,830. Trade prices on purchases made were $8,664. The total extra cost to the city for the two years was $12,483.50.

On the last purchase of fire-alarm boxes, in January, the city paid an additional price of $4,125. Last December there was a similar purchase of fire boxes, with an additional price of $4,125. Next to the fire and police boxes the joker outfits are the largest items on the bills of the Police Telephone & Signal company. For nine outfits the city paid $2,875. The cost, according to market prices, might have been $793.

The use of the joker outfit in an engine house prevents the giving of alarms unless the fire for which the alarm was sent is in the company's district. The fire-alarm service was patented by Prof. Barrett in 1876, and perfected in 1888 with the addition of the joker. The joker outfit includes a single—pen, ink—writing register, a relay, a sounder, a polarized relay, a telegraph key, a switchboard for grounding, testing and cutting out five circuits and two plain push-buttons for operating a switch. The outfit is mounted on a heavy oak board, and is equipped with a telephone. Some of the outfits have a small tap bell.

Of this outfit the Western Electric company furnishes the Police Telephone & Signal company with the register, relay, polarized relay, sounder and key. The outfit is sent to the city repair-shops, and there the telephone is attached. The Gamewell agents, however, insert the item "telephone board" in their bills. The telephone itself is rented from the Chicago Telephone company.

The catalogue of the Western Electric company lists their standard single-pen ink-writing register at a net price of $40.50 to the trade. This is not the identical register used by the city, but is the highest-priced standard single-pen register sold by the company, and is recommended for fire-alarm service. The highest-priced telegraph key similar to the one used by the city is sold for $1.50. The highest-priced similar sounder is sold for $2.10. The highest-priced similar relay is sold for $4.10.

Push-buttons similar to those used are worth $1.16 a pair. A five-line switchboard is sold by the Western Electric company for $9.30. The polarized relay used is sold exclusively through the Western Union company. For this the Police Telephone & Signal company charges $25. It has been quoted to firms for $11, but in the estimate of the *Record* the price of $25 is used. The marshal's joker outfit has no register, plain relay nor push-buttons.

The aggregate cost of the instruments in the engine-house joker outfit is thus seen to be to the trade $83.66. An allowance of about $5 being made for the boards on which it is mounted, the cost would approximate $89 to the trade, against $325 to the city. The instruments in the marshal's joker are worth $37.90, a similar addition for boards bringing the cost to $43 to the trade, against $125 to the city.

Other charges on the bills of the Police Telephone & Signal company are much higher than trade prices. Fire-alarm box-locks are billed at $4 apiece. The United States company lists the same lock at $2.50. Cut box-door keys are billed at 10 cents each. Similar keys can be bought in the city for five cents. Dry battery cells are charged at 75 cents each, while the batteries purchased of the Western Electric company cost 45 cents.

The following comparison of trade or bid prices and city prices shows the extra cost to the city on goods purchased of this company, the items being copied from the bills of the company in the fire marshal's office February, 1896:

	Cost to city.	Trade price.
6 fire-alarm box locks, $4	$24.00	$15.00
MAY, 1896.		
1 marshal's private joker outfit, with No. 2 telephone board	125.00	43.00
1 new-style chemical register	125.00	125.00
JULY, 1896.		
1 improved engine-house joker outfit, with No. 1 telephone board	325.00	89.00
1 improved engine-house joker outfit, with No. 1 telephone board	325.00	89.00
1 improved engine-house joker outfit, with No. 1 telephone board	325.00	89.00
SEPTEMBER, 1896.		
15 fire-alarm box doors, $2.50	37.50	37.50
1,000 cut fire-alarm keys, .10	100.00	50.00
25 police signal-box verge wheels, $2	50.00	50.00
25 police signal-box verges, $1.75	43.75	43.75
1 central office inking register	150.00	40.50
OCTOBER, 1896.		
1 improved private joker outfit, complete	125.00	43.00
1 improved engine-house joker outfit, complete, with No. 1 telephone board	325.00	89.00
2 improved private joker outfits	250.00	86.00
1 chemical register	125.00	125.00
1 joker relay K. O. B.	25.00	11.00
NOVEMBER, 1896.		
1 chemical register	125.00	125.00
DECEMBER, 1896.		
1 improved joker outfit, complete, with No. 1 telephone board	325.00	89.00
100 cells dry battery, .75	75.00	45.00
75 fire-alarm boxes, $100	7,500.00	3,375.00
25 police telephone signal boxes, $75	1,875.00	1,875.00
2 improved jokers, No. 1 board, $325	650.00	178.00
Totals	$13,030.25	$6,712.75
Extra cost		$6,317.50

Following is the account for 1895:

February 13—1 private joker outfit	$125.00	$43.00
July 23—1 N. S. chemical register	100.00	100.00
August 31—1 improved private joker	125.00	43.00
November 14—100 cells, Monitor dry battery	75.00	45.00
November 14—2 engine-house jokers	650.00	178.00
November 14—1 verge wheel	5.00	5.00
December 26—100 F. A. signal boxes	10,000.00	4,500.00
December 26—50 police signal boxes	3,750.00	3,750.00
Totals	$14,830.00	$8,664.00
Extra cost		$6,166.00

Another Pacific Cable Bill.

Senator Gray of Delaware has introduced a bill "To rerevive and amend and extend the act of Congress of August 15, 1876, to encourage and promote telegraphic communications between America and Asia, across the Pacific Ocean, from the western shores of the United States to the Hawaiian Islands, to Japan and China." Attention is directed to the fact that on the day mentioned Congress passed an act granting to Celso Caesar and his associates the right to construct, maintain and operate a submarine cable system on the Pacific coast of the United States to connect the American and Asiastic coasts by telegraph. Many of those engaged in that project are now dead or unable to proceed with the enterprise, and it is accordingly proposed to transfer these privileges to C. C. Moreno and his associates, provided they shall begin construction work within three years.

It is provided by the bill that the government of the United States shall be entitled to exercise and enjoy similar privileges with regard to the control and use of the cable that may, by law, agreement, or otherwise, be exercised and enjoyed by any foreign government. Citizens of the United States shall enjoy the same privileges as to the payment of rates for the transmission of messages as are enjoyed by the citizens of the most favored nations. The transmission of dispatches shall be made in the following order: Dispatches of state, under such regulations as may be agreed upon by the governments interested; dispatches on telegraphic service, and private dispatches. The lines of cables shall be kept open to the public for the daily transmission of market and commercial reports and intelligence, and all messages, dispatches and communications shall be forwarded in the order in which they are received, except as provided. Before extending and establishing any line or lines or cable or cables in or over any waters, reefs, islands, shores, and lands within the jurisdiction of the United States a written acceptance of the terms and conditions imposed by the act shall be filed in the office of the secretary of state by C. C. Moreno and his associates.

The bill was referred to the committee on foreign relations.

J. F. Pattoo, J. W. Peery, J. A. Tipton and others have incorporated the Albany Telephone company at Albany, Mo.

Mr. Arnold's Lectures at the University of Nebraska.

Much interest was aroused in the city of Lincoln, Nebraska, by the course of lectures on "Design and Construction of Electric Power Plants" delivered before the Department of Electrical and Steam Engineering of the University of Nebraska by B. J. Arnold of Chicago on March 15th to 19th inclusive. The lectures of the series were delivered in the physics lecture room of the university and were illustrated by lantern-slide pictures and drawings. The attendance was large, including many of the officers and professors of the university and not a few engineers outside of Prof. Owens' department, and the interest seemed to steadily increase as the course progressed. Friends of the university felt a particular gratification and pride in Mr. Arnold's appearance as a successful engineer and lecturer, as he was a student in the same institution some 18 years ago. The newspapers gave daily reports of the lectures, which, they said, were highly appreciated. Mr. Arnold was the recipient of flattering social attentions, and on the last evening of his stay was tendered two receptions—one by the Delta Tau Delta fraternity, the lecturer's college society, and the other by the Electrical Engineering society of the university.

By an especial arrangement with the author, the WESTERN ELECTRICIAN has secured the exclusive right to the publication of these lectures. A comprehensive abstract of the first one, "Possible Sources of Energy," is given in this issue, and the other ten will follow at frequent intervals. The titles of the succeeding lectures are as follows:

2. Cost of the Production of Power.
3. Boilers and Accessories.
4. Water Supply Pumps, Condensers, Heaters, Economizers, etc.
5. Engines.
6. Piping.
7. Connections between Engines and Generators.
8. Generators and Switchboard.
9. Storage Battery Auxiliaries.
10. Preliminary Determinations.
11. Buildings and General Arrangements.

Electric Power for the Suburban Service of the Illinois Central.

At a meeting of the directors of the Illinois Central Railroad company last week it was decided to electrically equip that portion of the road used for suburban service between Randolph and Sixty-seventh streets in Chicago. The distance between these points is nearly nine miles, and the company handles a very heavy suburban business in this district, as the road serves the best residence portions of the South Side. Many steam locomotives are used for the service; and the change, which has been long in contemplation, is made to secure economy in labor and fuel. John F. Wallace, the chief engineer for the company, has the matter in charge, and he will issue specifications and receive bids. Mr. Wallace has made a study of electric traction—especially its adaptability to the conditions existing in the present practice of steam railroad companies—and he is well fitted for the task in hand.

The power house will be located on one of several available sites belonging to the company along the line of the road, and it is not decided whether overhead trolley wires or surface contact rails will be used to distribute the current. The latter might easily be employed, with proper precautions at a few crossings, as the company's right of way is so located and hedged in (partially elevated, also) that there should be little danger from shock to men or beasts. It is said that three-car trains run at very frequent intervals will constitute the train service. The service will be entirely distinct from the operation of the steam-car trains and will constitute a department by itself. Work is to be begun as soon as possible.

Biloxi, Miss., a town situated on an arm of the Gulf of Mexico, and noted for its fish and oyster packing industry, is perhaps the largest place in the United States without the benefits of telephonic communication. This is to be speedily remedied, however, by the People's Telephone company, which has been organized to do business in Biloxi, and which has contracted with the D. A. Kusel Telephone Manufacturing company for a complete exchange outfit, including a switchboard of capacity for 200 instruments.

Texas Street Railway Association.

The Texas Street Railway association convened in Austin, Tex., March 17th, and its deliberations occupied two days. There were represented the Laredo Electric & Railway company, the Austin Dam & Suburban Railway company, the Austin Rapid Transit Railway company, the Elm Street line of Dallas, the Dallas Rapid Transit company, the Fort Worth City Railway company, Houston City Electric Street Railway company, the San Antonio Street Railway company and the San Antonio Edison company.

The meeting was called to order by Carl F. Drake, vice-president of the association, who spoke feelingly of the loss of the organization and the community in the death of Colonel Sinclair, the president of the association. He then introduced Mayor Hancock of Austin, who made a brief address welcoming the delegates.

The first order of business was the appointment of committees. The chairman made the following announcements:

Resolutions: C. B. Hendricks, Fort Worth, chairman; H. C. Chase, Houston, and J. D. Chiles, Austin.

Constitution and By-laws: H. C. Chase, Austin, chairman; C. F. Yaeger, Laredo, and C. L. Wakefield, Dallas.

Topics for Next Meeting: George D. Hartson, Dallas, chairman; R. S. Wakefield and D. D. Willis, San Antonio.

Membership: A. H. Hayward, Houston, chairman; D. D. Willis and B. H. Hammond, San Antonio; Henry Garrett, Dallas; J. K. Urie, Galveston.

Legislation: F. E. Scovill, Austin, chairman; I. H. Evans, Austin; W. H. Weiss, San Antonio; Julius Runge, Galveston; C. L. Wakefield, Dallas.

The last three named committees were made permanent.

The association then took up the discussion of the subject of "Uniform Rate of Wages and Number of Hours Worked." It was developed that in the main 12½ cents per hour was paid. Several roads had the three man to two-car swing system. A few had long-hour days, with third or fifth day off; in the latter case the wages were from $40 to $55 per month. There seemed to be no uniformity as to the number of men worked in barn or repair shops. A discussion followed on the life of pinions and gears. The next question was "Legislation, State and Municipal." The question of passes was also considered. City officials, newspapers, policemen and firemen seemed to be the chief beneficiaries.

The committee on topics for the next meeting reported the following subjects for discussion:

Power Construction.
Overhead Construction.
Construction and Maintenance of Car Bodies.
Brakes.
Discipline of Employes.
Rail Joints.
Methods of Increasing Traffic.

On recommendation of the committee the list was left open.

Papers were read on the following topics:

"Accidents, Their Liability and How to Prevent," by R. S. Wakefield, San Antonio.

"Amusements," by J. K. Urie, Galveston.

"How to Obviate Public Prejudice Against Corporations," by George B. Hendricks, Fort Worth.

A general discussion of the following subjects was held: How to Make Street Railway Employes Honest, Repair Shop; Single and Double Tracks. The joint occupation of track, which is the subject of a bill before the Legislature, was discussed several times.

Carl F. Drake was elected president for the year 1897-1898, A. H. Hayward vice-president, and C. L. Wakefield secretary.

The next place of meeting will be San Antonio.

J. P. Morgan, the Telephone and the Telegraph.

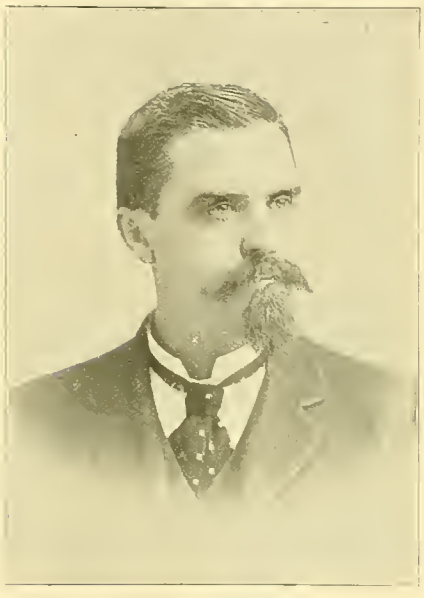
J. Pierpont Morgan sailed for Europe on March 24th. In mentioning the departure of the eminent financier and his probable participation in the negotiations for the refunding of the New York Central bonds of foreign holders, the *New York Tribune* says:

Mr. Morgan's foreign trip may also have an important relation to the future of the American Bell Telephone company. It has been reported that he recently acquired a large block of the company's stock. The rumor was current again yesterday that the Bell company was going generally into the telegraph business. There would seem to be much significance in the fact that the New England Telephone & Telegraph company, the largest of the Bell sub companies, has already gone into the telegraph business, and provides message blanks similar to those of the Western Union and Postal telegraph companies. It is fair to assume that other Bell sub-companies will follow suit. The Bell owns a majority of the stock of the sub-companies, and, accordingly, nothing can be done which the Bell company does not sanction. There are about 700,000 telephones in use in this country, with about 500,000 miles of wire and about 300,000 stations. The territory east of Milwaukee and north of the Ohio river is pretty well covered by the long-distance telephone service, which is operated by a sub-company of the Bell company, known as the American Telephone & Telegraph company.

Lara C. Baker.

By the death of Lara C. Baker on March 25th at his home in St. Louis another of the war-time figures in American telegraphy has passed away. Mr. Baker was 55 years of age and for a number of years had been superintendent of the southwestern district of the Western Union Telegraph company, with headquarters in St. Louis. His death was comparatively sudden and the announcement came unexpectedly to many of his friends, although it is stated that Mr. Baker fainted on the street a few weeks ago. The deceased was married and left a large family. The funeral services were held on Sunday, March 28th, in Christ church, Little Rock, Ark. Many prominent Western Union men were in attendance, including Col. R. C. Clowry, general superintendent; C. H. Summers, electrician, and F. H. Tubbs, district superintendent, of Chicago; John F. Wallick, district superintendent, at Indianapolis; T. P. Cook, assistant district superintendent at Dallas, Tex.; R. H. Bohle, manager, and G. J. Frankel, chief clerk, St. Louis.

As a boy, L. C. Baker entered the telegraph business



LARA C. BAKER.

in 1855 or 1856. He was a Southerner, born in Alabama, and the South or Southwest was always the scene of his efforts. He was a step-son of John Van Horne, and started in under the tutelage of that veteran in the telegraphic service. The line construction in the South in those days was of the crudest description, the iron wire being supported on trees for much of the distance. Young Baker served his "'prentice hand" at a small station in the woods; and Reid, in his book, says that the boy "learned to climb like a squirrel, and make good joints." After a few years' experience of this sort the young operator was promoted to a more responsible position in the office at Memphis, and in 1860 he again transferred the scene of his operations to Arkansas, accepting the management of the office at the southern terminus of the first telegraph line in that state. When the line was completed to Little Rock, Mr. Baker was put in charge of the office in that city, and for 12 years thereafter, with considerable absences, he made Little Rock his home, whether connected with the Arkansas Telegraph company, the Confederate government, the Southwestern Telegraph company or the Western Union company, as he successively was.

During the war Mr. Baker allied himself with the Confederates, and he was virtually superintendent of military telegraphs for the rebel forces in the Southwest. Reid says: "In this service he had his opportunity. He directed the building of about 1,500 miles of new war lines, and cleaned the country of everything made of zinc and the drug stores of bi-chromate of potash to work his batteries. He tried his genius in the use of iron castings and copperas for a battery when desperate for material, but there seemed something wrong about the compound, and the taste was bad. All this experience sharpened Mr. Baker's wits, which were normally quick enough, and he has since ranked among the foremost of the active telegraph managers of the West." Mr. Baker was in this service opposed to Col. R. C. Clowry, then in charge of the United States military telegraphs in the Southwest, and the two men grew to respect and esteem each other, although espousing opposite sides of the national quarrel. Many were the expedients—the ruses, sorties and stratagems—to acquire and retain telegraph apparatus, which ranked in value with quinine and good whisky. The adventurous exploits and humorous and pathetic incidents of this time and period form several of the most interesting chapters in the unwritten history of the operations of the military telegraphers during the civil war.

In 1866 Mr. Baker was again peacefully in charge of the Little Rock district of the Southwestern Telegraph company and Col. Clowry was district superintendent for the Western Union at St. Louis. When the Southwestern was absorbed by the Western Union the value of Mr. Baker's services was recognized, and he was made assistant district superintendent of the Western Union at Little Rock. When, some 20 years ago, Col. Clowry came to Chicago as general superintendent of the western division of the Western Union territory, Mr. Baker succeeded him as district superintendent at St. Louis. This position he held until his death last week.

American Institute of Electrical Engineers.

At the meeting of the Institute held at 12 West Thirty-first street, New York, on March 24th, a paper was presented by Dr. Karl E. Guthe on "The Influence of Heat Treatment Upon the Magnetic Properties of Hardened Steel." In the absence of the author the paper was read by Prof. H. S. Carhart of the University of Michigan, who took part in the discussion, together with Dr. Pupin and Mr. Winand.

At the council meeting in the afternoon the following-named associate members were elected: Ernest J. Bechtel, Toledo, O.; Arthur Hillyer Ford, Madison, Wis.; Herman L. Holbrow, New York city; William F. Kelly, Fort Wayne, Ind.

It was decided to hold the general meeting of the institute at Greenacre-on-the-Piscataqua, Eliot, Maine, beginning Monday, July 26th. This date is the 50th anniversary of the entrance of the late Prof. Moses Gerrish Farmer into the field of electricity, which became his life work. Prof. Farmer was one of the charter members of the Institute, and in consideration of his high standing as an original investigator and inventor he was elected an honorary member of the Institute, October 21, 1890. His home during the latter part of his distinguished career was at Eliot, Maine, and he died at Chicago May 25, 1893, where he had been engaged in the preparation of his personal exhibit at the World's Fair.

The council nominees for the Institute election on May 18th are as follows:

For president—Dr. Francis B. Crocker of New York city.

For vice-presidents—Dr. A. E. Kennelly of Philadelphia, Pa.; Charles S. Bradley of New York city; Professor Dugald C. Jackson of Madison, Wis.

For managers—Dr. Alexander Macfarlane of South Bethlehem, Pa.; Gano S. Dunn of New York city; W. F. C. Hasson of San Francisco, Cal.; Herbert Laws Webb of New York city.

For treasurer—George A. Hamilton, New York city.

For secretary—Ralph W. Pope, New York city.

The officers whose terms have not expired are: Vice-presidents, Charles P. Steinmetz of Schenectady, N. Y.; Professor Harris J. Ryan of Ithaca, N. Y.; Professor Wilber M. Stine of Chicago, Ill.; managers, Charles F. Scott, Pittsburg; Bion J. Arnold of Chicago; Carl Hering of Philadelphia; Dr. Cary T. Hutchinson, John W. Lieb, Jr., and F. A. Picknernell of New York city; Professor William L. Puffer of Boston and L. B. Stillwell of Niagara Falls.

Motor-driven Arc Dynamos.

In an elaborate article describing the great Duquesne furnace plant of the Carnegie Steel company at Cochran, Pa., the *Iron Age* devotes this paragraph to the electric light and power plant: "The widespread use of electric cranes and the lighting requirements call for an elaborate electric plant, which is installed in [a building 50 by 191 feet.] The power house contains three 500 horse power generators driven by a compound horizontal tandem Buckeye engine with Blake condensers. The engines have 18 inch high pressure, 32½ inch low pressure cylinders and 33 inch stroke, and run at a speed of 130 revolutions per minute. The generators are operated in parallel and supply power to the large number

of direct current 220 volt motors used for power purposes throughout the plant. Six direct constant current 60 light arc dynamos supply current to the arc lamps in the various buildings and yards. These machines are direct-connected to six 50 horse power Westinghouse motors, which are operated by the generators. Each of the six units of motor and arc machine are erected upon a separate foundation. On a similar foundation is a 45 kilowatt alternating single-phase generator which is also direct-connected to a motor and excited by current from the large generator. This machine is used for supplying current to about 900 incandescent lamps. A 10 ton crane spans this building, the lower end of which is utilized as a repair shop."

Exposure of Strike Leaders by Philadelphia Street Railway Company.

The employes of the street railway company at Philadelphia learned last weeek of the perfidy of their leaders through a scheme of the company for exposing the guilty men. Hiram Lutz was the labor agitator who two years ago organized a strike of city passenger railway employes in Philadelphia and provoked a riot. On March 22d he was exposed in an attempt to sell out the organization of street railway employes which he has fostered during the past year. The treachery of himself and William H. Copeland, self-constituted leaders in the new organization, was laid bare in the office of Assistant General Manager Shaufler of the railroad company. A delegation of motormen and conductors, concealed in an adjoining room, heard all of the proceedings and burst in upon Lutz and Copeland in the midst of their discussion with Mr. Shaufler, and it was with difficulty that the enraged men could be restrained from killing the agitators.

Lutz and Copeland have been engaged for several months in attempting to organize the motormen and conductors preparatory to another strike. Organizations have been started among the employes of different divisions of the Union Traction company's system, and a large number of discharged employes were enrolled. At some of the depots, also, a small proportion of the men at work have joined in the movement, although the majority refused to have anything to do with it on account of Lutz's rabid leadership and of the feeling against heedlessly stirring up more trouble. Inflammatory circulars have been distributed among the men, and every means used to band them together to serve the purposes of the leaders.

Lutz and Copeland called on Assistant General Manager Shaufler and made a proposition to him to "sell out" the organization they represented. Upon asking them what binding assurance they would give that they would be loyal to the company, they expressed their willingness to put their propositions in writing. This they did, and gave Mr. Shaufler the letter containing their terms and signed with their names. Mr. Shaufler then made an engagement with the two agitators "to talk the thing over." They had given him the names of about 20 of the employes, who, they said, were leading spirits in the new organization. Mr. Shaufler sent for ten of these employes and showed them the signed agreement of Lutz and Copeland, and then concealed them in an office adjoining his own with the door open, to hear everything that was said. The scene that followed is described by one of the men:

Lutz came into Mr. Shaufler's room alone. We heard him tell Mr. Shaufler that if the company would give him $15 a week he would be loyal to the company and expose all the workings of the organization. These were the terms he stated in his written agreement. He said he was in a position to do the company good service, and that the thing could be worked on the dead quiet. We couldn't stand it any longer and we rushed in on him.

Lutz was badly frightened when the men pounced upon him. He was hustled out of Mr. Shaufler's office. Lutz struggled and cried for mercy as the men took him down stairs. At the foot of the steps detectives rescued Lutz and guarded him to the front door, where he escaped down Dauphin street. Copeland meantime had been in an office in another part of the building. The men promised not to make another scene, and Copeland was brought into the assistant general manager's office and repeated his terms. He wanted $25 a week for a year or $1,000 cash. The men were called in for Copeland to face. Without attempting an explanation he slunk out of the office.

At the third annual meeting of the Texas Gas & Electric Light association at San Antonio on April 19th, 20th and 21st, J. R. Cullinane of Denison will read a paper on "Meter Rates versus Flat Rates." The committee on exhibits, of which W. E. Holmes of Austin is chairman, is inviting displays of lighting apparatus, and hopes to secure a good line of appliances.

Design and Construction of Electric Power Plants.

[*Continued from page 188.*]

and hence the theoretical efficiency is considerably less than that of engines of the internal combustion type. Hot-air engines have been constructed by Ericsson, Stirling and others, but this type has never been considered commercially practical for installations of any magnitude, although it is not improbable that we may see marked improvements in this direction in the near future, for there is at present being experimented upon in Philadelphia an engine which operates under extremely high temperatures—so high that the cylinder is maintained at a red heat, which necessarily gives very high initial temperatures. This means that if the terminal temperatures can be exhausted low enough the efficiency of this engine will be very high, for it comes under the second law of thermo-dynamics, but there has not been sufficient information published about it to attempt to give a description of it.

Other Heat Engines.—From time to time engines have been developed using ether, bisulphide of carbon or some other volatile fluid as the working substance, and there have been constructed "binary" heat engines; that is, an engine with two working fluids, one of which is generally water, the heat of condensation of which is used to evaporate the more volatile fluid. There is a very small possible increase in efficiency to be hoped for in this direction, however.

The Steam Engine.—By far the greater part of electrical energy produced to-day is generated through the agency of the steam engine, but unfortunately it falls under that same inexorable second law of thermo-dynamics. Let us examine the formula for efficiency.

$$E = \frac{T_1 - T_2}{T_1}$$

Suppose an engine working at 100 pounds pressure (equivalent to 327½ degrees Fahrenheit or 788½ degrees absolute) exhaust into the atmosphere or against a back pressure of 14.7 pounds (equivalent to 213 degrees Fahrenheit or 674 degrees absolute) then

$$E = \frac{788\frac{1}{2} - 674}{788\frac{1}{2}} = 14\frac{1}{2} \text{ per cent.}$$

This figure shows the maximum possible theoretical efficiency, which, practically, would be materially reduced by the friction of the moving parts, the losses by heat radiation, cylinder condensation, etc.

It will be seen that any increase in the efficiency of the steam engine must be made by increasing the steam pressure and at the same time decreasing the back pressure.

The initial temperature of the steam is naturally limited by consideration of safety. The limit, or the greatest possible pressure which it is practicable to build engines and boilers to withstand, may be taken at 250 pounds, which corresponds to 401 degrees Fahrenheit. To work such pressure would, of course, require four or five expansions. The temperature of water for condensation cannot be below freezing, and practically a limit of 60 degrees Fahrenheit would be very low. Taking these conditions as the greatest possible working limits of temperature, we have the best possible theoretical efficiency as follows:

$$E = \frac{(401+461) - (60+461)}{401+461} = \frac{341}{862} = 39\frac{1}{2} \text{ per cent.}$$

If the pressure is less than 250 pounds the efficiencies will be as follows:

Initial pressure in lbs. per sq. inch...	40	80	120	160	200
Highest ideal efficiency.....	.284	.326	.350	.368	.381

But, of course, it is understood that these efficiencies have not been attained in practice, and the figures will only serve to show the limit of efficiency we may hope for in the steam engine.

The thermal efficiency attained in practice by the most modern steam engines is far below the theoretical figures. Suppose we compare the amount of coal actually required to produce a horse power hour with the amount of coal theoretically required to do the same amount of work, we shall gain some idea of how imperfect is our present system of electrical generation.

One horse power hour is equal to about 2,000,000 foot-pounds, or an equivalent of about 1,500 heat units, or the amount of energy produced by the combustion of about one-fifth of a pound of good coal. The very best results in coal consumption per horse power hour in the most modern steam engine is about two pounds, or about 10 times the theoretical amount required. These figures of course include the boiler or steam generator.

We have now compared somewhat carefully the relative merits and efficiencies of the different sources from which we secure power, either in the form of electricity direct or of mechanical rotative motion, and while the gas engine promises the best, we are still compelled to depend upon the steam engine, which has been shown to be capable of utilizing but 28 to 38 per cent. of the heat of the steam delivered to it, and at its best only 18 per cent. of the heat of the fuel burned under its boilers, while in most cases this seldom exceeds 10 per cent.

A man in New York advertises that while electricity may not have been the direct cause of Fitzsimmons winning the recent prize-fight, "it cannot be denied that it influenced the result to a large extent." This curious claim is put forth on the strength of the statement that, before leaving for Carson City, the pugilist "was treated by electricity from a large static machine." This was at once soothing and stimulating, it is claimed, and prepared the fighter for the hard training he underwent subsequently.

Governmental Telegraph Bill.

A bill has been introduced in the Senate by Senator Kyle to provide for a government telegraph system within the United States, to be under the government of a board consisting of the secretary of state, the secretary of war and the postmaster-general, and shall consist of four trunk lines connecting the northeastern, the northwestern, western and southwestern, and the southern part of the United States with the city of Washington. These trunk lines shall be connected with lines and offices established at such cities, towns and other places as shall be for the public interest for the time being; all to be extended and increased as Congress may from time to time provide. The bill further specifies that this telegraph line shall be operated as a part of the posta. system of the United States, and the rates shall be established by the board already named. The bill also provides that there shall be no discrimination in the matter of charges and rates with the exception of messages for the press, and in that case no publisher of any one newspaper or combination of newspapers shall be allowed better rates than any other.

It is provided that this government telegraph line shall be constructed and kept in repair under the direction and superintendence of the secretary of war and through the corps of engineers. The secretary of war is authorized to acquire by purchase, subject to the approval of the president, the right of way for the construction of this line, and he is also authorized to construct or take and use all machinery, appliances, devices and materials, including telegraph lines owned by persons and corporations, whether patented or not, as shall be deemed necessary for the establishment and operation of the lines; and in case the secretary cannot agree with the owners as to the value of such property, the owners shall be entitled to file a petition for just compensation in the Court of Claims of the United States.

Clerks and other persons employed in the receiving, transmitting and delivery of telegraph messages over these lines shall be deemed officers and persons employed by the United States, and will be employed by the postmaster-general.

The sum of $5,000,000 is appropriated for the purposes mentioned in this act for the fiscal year ending June 30th.

The working and operation of these lines shall be under the charge and direction of the postmaster-general and a part of the postoffice establishment of the United States.

It is still further provided that nothing in this act shall be construed to prohibit individuals or corporations from carrying on the business of operating telegraph lines.

COMMUNICATION.

Litigation Over Car Heating Apparatus.

To the Editor of the WESTERN ELECTRICIAN:

With reference to your note in regard to "litigation over car heating apparatus" in issue of March 27th, we beg to state that we fairly stated the case as it was and the decision is of considerable importance. All that we said that was positive and definite in the matter were quotations from the judge's decision. We will be pleased to enclose you copy of full text of his decision and call your attention to the fact that he states that the particular form of indicator used by the Consolidated company is not the same in any respect as that shown in the patent, nor is the arrangement of switches, heaters and indicators similar, and he clearly states that the particular form is not material, but the infringement consists in using an indicator in combination with a number of circuits and electric heaters, said indicator to show the variations in heat made by the switch, and that any indicator used for this purpose in this combination constitutes an infringement. It is perfectly clear that where it is desirable to control a number of circuits to regulate the heat a single switch to produce the result is most desirable. Street car companies usually object to putting in a switchboard with a number of switches for controlling heaters, and where a single switch is used without an indicator there is no means of knowing what heat is being supplied. Now, as an indicator in this combination is an absolute essential where a single switch is operated to produce the results, we feel sure that the advantage gained in the decision is very material.

The desirability of this method of operating car heaters is apparent when it is understood that the Consolidated company has made practically all its installations in that manner.

AMERICAN ELECTRIC HEATING CORPORATION,
JAS. I. AYER, General Manager.

Boston, March 26, 1897.

The Union Telephone company of Easton, Md., will construct a line from St. Michael's to Royal Oak and Easton.

Apparatus of the Western Telephone Construction Company.

Some of the recent forms of apparatus turned out by the Western Telephone Construction company, Chicago, are illustrated herewith.

Fig. 1 shows this company's Western Giant A telephone, its standard exchange and long-distance instrument. This instrument is finished in either oak or walnut, and presents a very neat appearance. The receiver is of the bipolar type with a patented adjustment which prevents the expansion or contraction due to heat or cold from varying the distance between the diaphragm and the pole-pieces. The transmitter is of the granular carbon type, and is provided with a mouthpiece agitator, so that a simple turn of the mouthpiece will completely agitate the carbon granules, and thus avoid the difficulties due to packing. The hook switch has been recently remodeled and is platinum-pointed throughout. The generator and call bell are of the latest design. An automatic shunt-break mechanism closes a low resistance path around the armature of the generator at all times when it is at rest. Turning the crank of the generator opens this shunt and allows the current to pass out over the line.

Figs. 2 and 3 show, respectively, the portable and swinging arm desk sets of this company. These instruments are each provided with a separate generator and bell box which may be secured under the desk, or in any convenient place within the reach of the user. The portable set may be slid around upon the top of the desk into any desired position, while the swinging arm is secured firmly to the top of the desk, but may be swung back out of the way, as desired. These instruments are very efficient in operation, and excellent taste is displayed in their design. Simplicity and elegance characterizes their general make-up, and an absence of useless ornamentation is conspicuous.

Fig. 4 shows a 50-line lightning-arrester strip. This apparatus provides a fusible cut-out for each line, as well as a means for conducting charges of high potential harmlessly to ground.

This company reports a large increase in business, and is at present making arrangements for trebling its available manufacturing facilities. Its telephone instruments speak for themselves.

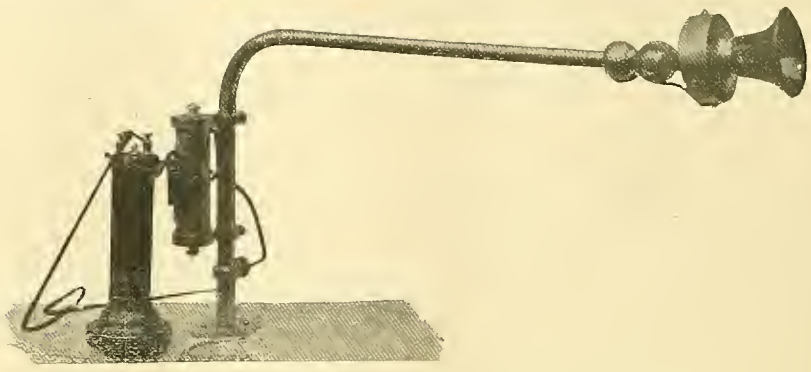


FIG. 3. APPARATUS OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

FIGS. 1, 2 AND 4. APPARATUS OF THE WESTERN TELEPHONE CONSTRUCTION COMPANY.

The Iowa Telephone company is preparing to install selective party-line service at Ottumwa, Ia.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

A telephone exchange is being put in at George, Ia.

The telephone line from Bathgate, N. D., to Pembina has been completed. It is owned by Frank A. Willson. It is to be extended to Grafton.

Dr. Albert Blocklinger of LaMotte, Ia, and others propose to make telephone connection from La Motte east for the benefit of farmers. It is to be free.

The Jefferson Telephone company of Jefferson, Ia, will extend its system through Sac county, Ia., to connect with the Independent company at Sioux City.

The Iowa Telephone company will put in an exchange at Monticello, Ia.

The Werner & Dwelle Telephone company is arranging to put in a 75 drop board and exchange at Lake City, Minn.

The Marshall Telephone company of Marshalltown, Ia., has 376 subscribers and is considering a larger switchboard. The present one's capacity is 400, which was thought to be amply large when put in, less than a year ago.

The Western Electric Telephone company has been incorporated at Sioux Falls, S. D., by T. A. Potts and F. A Way of Britt, Ia; S. T. Way of Wesley, Ia.; Fred Dunn, Canton, S. D., and Charles E. Hill of Valley Springs, S. D.

The LaCrosse & Southwestern Telephone company of La Crosse, Wis., is preparing to extend its line to Mauston, Tomah and other points, also La Valle and Reedsburg.

J. E. Keelyn, of the Western Telephone Construction company of Chicago, is again in the Twin Cities with a project for independent telephone exchanges for each. The proposed exchanges are to connect with the Western Electric Telephone system which covers northern Iowa pretty thoroughly, the Union Electric Telephone company of Waucoma, Ia., and others, giving extensive long-distance connection with Southern Minnesota and Iowa towns. A line to Duluth is promised soon after the Twin City exchanges are completed. Following the project of Mr. Keelyn comes one which proposes to install the automatic instrument made by the Drawbaugh Telephone & Electric Appliance company. This company proposes a central exchange midway between Minneapolis and St. Paul to answer for both towns.

The Iowa Telephone association will meet at Cedar Rapids, Ia., this summer, probably in June. Arrangements will then be completed for connecting all the independent telephone companies of the state. Preliminary steps to that end were arranged at the late meeting in Des Moines.

A company is proposed at Des Moines, Ia., to build long-distance telephone lines to connect with the new Mutual Telephone company, whose exchange is now being constructed.

Street Railway Accountants.

The meeting for the organization of the Street Railway Accountants' association of America was held at the Hollenden, Cleveland, O., March 23d and 24th. The meeting was called to order by H. H. Windsor of Chicago; Morris W. Hall of Camden, N. J., was elected temporary chairman, and W. B. Brockway of Toledo, O., temporary secretary. Committees on organization and nomination of officers were appointed.

The following-named gentlemen were present:

Frank R. Greene, secretary, Chicago City Railway company; Morris W. Hall, secretary, Camden & Suburban Railway company, Camden, N. J.; W. W. Herrick, adjuster, Cleveland Electric Railway company, Cleveland, O.; A. F. Walker, accountant, Allentown & Lehigh Valley Traction company, Allentown, Pa; William F. Ham, secretary, Nassau Electric railroad, Brooklyn, N. Y.; D. A. Keister, auditor, Marion City Railway company, Marion, Ind.; W. B. Brockway, auditor, Toledo, Bowling Green & Fremont Railway company, Toledo, O.; F. S. Borton, secretary, Cleveland, Painesville & Eastern Railroad company, Cleveland; Charles L. Wight, auditor, Toledo Traction company, Toledo, O; J. F. Calderwood, auditor, Twin City Rapid Transit company, Minneapolis and St. Paul, Minn.; F. T. Pomeroy, general manager and treasurer, Cleveland, Berea & Elyria Railway company, Cleveland; F. E. Smith, auditor, Lynn & Boston Railroad company, Lynn, Mass.; H. J. Davies, assistant secretary and treasurer, Cleveland Electric Railway company, Cleveland; E. S. Doud, secretary, Lehigh Traction company, Hazelton, Pa.; H. C. McJilton, secretary, Baltimore Traction company, Baltimore, Md.; H. L. Wilson, auditor, West End Street Railway company, Boston, Mass.; W. G McDole, auditor, Cleveland Electric Railway company, Cleveland; William R. Avery, auditor, Cincinnati Street Railway company, Cincinnati, O; W. S. Dimmock, general superintendent, Omaha & Council Bluffs Railway company, Council Bluffs, Iowa; P. V. Burington, auditor, Columbus Street Railway company, Columbus, O.; John Erhardt, assistant secre-

tary, Cleveland City Railway company, Cleveland; E. R. L. Tighe, accountant, Brooklyn Rapid Transit company, Brooklyn, N. Y.; W. G. Ross, comptroller, Montreal Street Railway company, Montreal, Canada; A. L. Lion, Jr., bookkeeper, Cleveland Electric Railway company, Cleveland; J. M. Smith, comptroller, Toronto Railway company, Toronto, Ontario; Dana Stevens, accountant, Eckington & Soldiers' Home Railway company, Washington, D. C.; C. E. Reavis, secretary, Augusta Railway & Electric company, Augusta, Ga.; E. D. Hibbs, auditor, Consolidated Traction company, Jersey City, N. J.; Walter M. Barnaby, chief accountant, Brooklyn Heights Railroad company, Brooklyn, N. Y.; C. N. Duffy, secretary and treasurer, Citizens' Railway company, St. Louis, Mo.; Robert V. McCullough, casbier, Southern Electric Railway company, St. Louis, Mo.; Henry H. Windsor, *Street Railway Review*, Chicago; Edward E. Higgins, *Street Railway Journal*, New York; T. E. Crossman, stenographer, New York.

Papers were read as follows:

"From Horse to Electric Accounts," H. L. Wilson.

"Suggestions for a Standard System of Accounts; Classification of Operating Expense Accounts, and Form of Report that Will Admit of Comparison and Diffuse Information Between Companies," C. N. Duffy.

"Monthly Closing of Accounts," Dana Stevens.

"Transfer Tickets," Frank R. Greene.

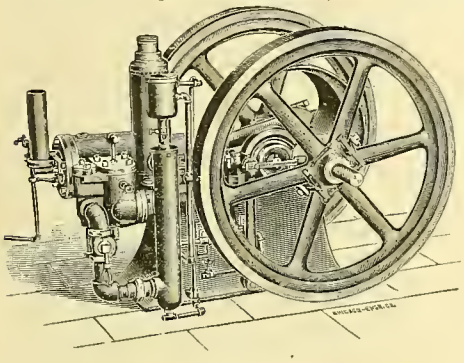
"The Relation of Accountants to Managers and Employes," P. V. Burington.

"A Simple System of Interurban Accounts," W. B. Brockway.

"Naming and Standardizing Apparatus." J. P. E. Clark.

"Depreciation," H. C. McJilton.

The following-named officers were elected: President, Henry L. Wilson, Boston, Mass.; first vice-president, C. N. Duffy, St. Louis, Mo.; second vice-president, J. F. Calderwood, Minneapolis, Minn.; third vice-president, C. E. Reavis, Augusta, Ga.; secretary and treasurer,



RACINE GAS ENGINE.

W. B. Brockway, Toledo, Ohio; executive committee, in addition to all of the foregoing, Dana Stevens, Washington, D. C.; W. S. Dimmock, Council Bluffs, Iowa; W. G. Ross, Montreal, Canada; E. R. L. Tighe, Brooklyn, N. Y.

The afternoon of Wednesday was devoted to an extensive ride over the lines of the Cleveland railways and an examination of several power houses. An interesting feature of the meeting was the large number of accounting blanks which were exhibited by the delegates.

The meeting adjourned to convene at the time of the meeting of the American Street Railway association, October 19–22, 1897, at Niagara Falls, N. Y.

Racine Gas Engine.

The Racine Hardware company at Racine, Wis., the well-known builder of high-grade automatic steam engines, has been engaged in the manufacture of gas and gasoline engines for about 10 years, having built, on contract, all the engines sold by several large concerns during that period. Its extensive facilities and complete equipment for this class of work, together with past knowledge and experience in the manufacture of gas and gasoline engines, has led the management to produce an engine of its own, which has many features of special merit. The accompanying cut shows the general appearance. The engine is proportioned as to weight to secure the greatest strength and durability, and is fitted with both hot tube and electric battery, insuring a constant means of igniting the gases in the cylinder, as in case the battery is allowed to get weak and need recharging the hot tube can be brought into service at once. The admission and exhaust chambers are in one casting and easily accessible. The engine only takes a charge at such time as additional power is required to maintain its regular speed, and these charges are regulated by the governor, which is very sensitive, responding promptly to any variation in the load carried. When the engine is not taking a charge the governor opens the exhaust valve, thus relieving the compression in the cylinder and imparting additional power to the engine. This engine is fitted so it can be used for either gas or gasoline. When gasoline is used the tank is placed outside of the building lower than the engine, and may be set in the ground, overcoming every element of danger, as just sufficient oil to keep the engine in operation at its maximum speed and power is brought to it by means of a small pump attached to and operated by the engine.

A visit to the extensive works of the Racine company shows the thorough system employed and the great care

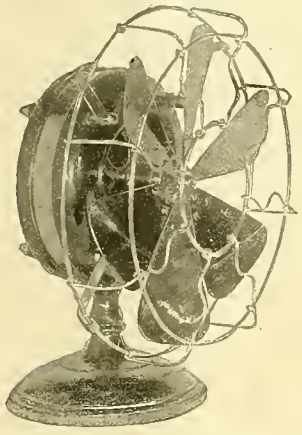


FIG. 1. GENERAL ELECTRIC FAN MOTORS.

exercised in every detail of the construction of the product. The testing room is equipped with the best of modern appliances for thoroughly testing machines, including two dynamos connected to a bank of 300 lights with all necessary instruments. Each engine is belted directly to a dynamo and kept in constant operation for 10 hours a day for two or three days just prior to shipment. The manufacturers state that, as a result of the great care they exercise in testing, together with the simple construction and superior devices employed in their engine and the thorough instructions furnished for setting up and starting them, they have never been obliged to send a man to set up and start a "Racine" engine. They may well take pride in this record.

Mascot Dry Battery.

J. H. Bunnell & Co. of 76 Cortlandt street, New York, claim to be the pioneers in bringing out the first practical American-made dry battery. The merit of this battery, together with the able manner in which it was handled, soon made it an acknowledged commercial suc-

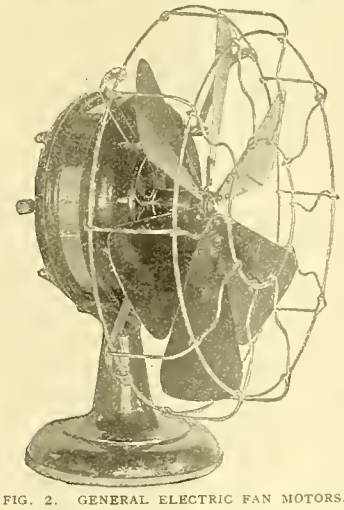


FIG. 2. GENERAL ELECTRIC FAN MOTORS.

cess, and, notwithstanding the fact that it was handicapped with a heavy royalty, Bunnell & Co.'s battery, on account of its acknowledged excellence, has continued in the lead, and its sales are estimated to have reached about a million cells. Bunnell & Co. have recently extended and improved the facilities for making their Mascot dry cells, and the quality of these cells is guaranteed to be the best for strength, durability and recuperating powers. The cut shows the general appearance of the Mascot cell.

It is said that not a few of the fashionable residents of Kenwood in Chicago now meet some of their formal social obligations by "telephone calls"—brief conversations over the wire in lieu of the conventional social call or card-leaving.

G E Fan Motors.

The General Electric company will this year, as last, place on the market fan motors for both alternating and direct currents, designating them as G E fan motors, '97 model. These fans retain the compactness and simplicity of the '96 models, with certain improvements.

The alternating current fan motor (Fig. 1) is made for operation on currents of either 60 cycles or 125 cycles. The speed is regulated by an inductive resistance operated by a three-point switch giving full speed and half-speed and cutting off the current at the third point. The presence of this switch allows of direct connection of the motor to the circuit without the use of a socket and plug connection—an appreciable convenience. The electrical design of this motor follows closely that of the '96 model. The field core is a ring of iron punchings with inwardly projecting poles carrying the field coils. The armature is a laminated core through which, near the periphery, are run bare copper rods riveted to copper disks at each end of the core. There are neither commutator nor brushes—rotation being produced by inductive action. This permits the core to overhang the bearing to such a degree that, together with the fan, a balance is effected, and the motor has but one bearing, long and provided with a self-oiling device, so that it does not heat. The inconvenience of flying oil is entirely done away with by this method. The fan is 10 inches in diameter.

The direct current fan motor (Fig. 2) also has but one self-oiling bearing. The commutator is completely enclosed and the small carbon brushes are encased in tubes which may be readily unscrewed for inspection. A regulating resistance and switch on the base allows of

MASCOT DRY BATTERY.

changes in the speed in the motor. The fan is 12 inches in diameter.

The finish of all '97 fan motors and fans is black japan, the guard, binding posts, nuts and screws being nickeled.

Hard Times Unknown in Michigan Copper Region.

Representative Sheldon of the Upper Peninsula of Michigan is one of the Congressmen who cannot understand why the Dingley tariff bill provides for a duty on copper. Mr. Sheldon lives at Houghton, which is in the very center of the copper mining district and but a few miles distant from the celebrated Calumet and Hecla mine, the owners of which control the copper market of the world. Mr. Sheldon is making no opposition to the proposed copper duty, because it makes no difference to his constituents and the Eastern men who own the Calumet and Hecla and other great copper mines whether there is a duty upon the imported product or not. As great quantities of copper are exported from the upper peninsular mines and little or none imported into this country, the object of the duty is not apparent.

In talking about the copper industry to a correspondent, Mr. Sheldon said that owing to the great demand for copper and the fact that it is found in so few places throughout the world, the owners of the upper peninsular mines are making a great deal of money, which finds its way directly into the pockets of his constituents, and that as a result the copper-mining district of the Upper Peninsula is probably the only portion of the United States that is more prosperous to-day than at any time in its history. Nothing is known there about the hard times, Mr. Sheldon says. Business is booming; every man is at work who will work; rental values are high and permanent, and every phase of the hard times of the past few years has passed them by untouched. The city of Houghton, in which Mr. Sheldon lives, has about 6,000 inhabitants. Every house in town is rented, and it is a serious matter how to provide for the rapid increase in population. This present increase is due largely to the fact that three great copper mines adjacent to the city are about to resume operations after having been closed down for many years. The increased demand for copper, owing to the many new uses to which it is being put of late, has made it advisable to resume the operation of these mines, which have never been worked beyond a few feet below the surface. As soon as their development begins, hundreds of miners will flock to the town for employment, and houses must be built to accommodate them.

The banks in the towns throughout the copper-min-

ing district have been doing a big business all through the hard times in other portions of the country, and, as an illustration of their condition, Mr. Shelden says that in the city of Houghton there is one bank with a capital stock of $150,000 that has $1,400,000 on deposit. The Calumet and Hecla mine owners are easily able to control the price of copper and they have kept the price at about 12 cents per pound. They will not allow it to go higher, for fear that the increased price would cause the use of other metals as a substitute for copper. Whenever, therefore, the market indicates that the price of copper is going up, they place a large block on the market and force down the price. The conditions in all the towns of the copper district are the same as at Houghton, Mr. Shelden says, and from his description the Upper Peninsula of Michigan is, in comparison with other parts of the United States at present, a veritable paradise.

The All-British Trans-Pacific Cable.[1]

This is the title of an article in the March number of *Blackwood's Magazine*. The history of the Trans-Pacific cable is a somewhat painful one. There is no question, and never has been, except from deeply interested parties, as to its practicability or as to its utility. Had it not been for the unceasing opposition of such interested parties, the cable would have been laid and at work long ere this. We do not blame the opponents, who had great monetary interests at stake, so much as the various authorities who refused to discount the arguments of the opposition and put the true value upon them. We have always supported the scheme, and have done so upon two grounds: (1) its great strategic importance to the empire; and (2) its commercial value. Its strategic importance ought long since to have brought assistance from the home government, and it is the lack of this assistance that delayed the carrying out of the project. The commercial importance was recognized by various colonies, who were prepared to grant subsidies. We must refer all readers interested in the subject to *Blackwood's* article for a highly compendious history of the project, for we are unable in the space at our command to do more than to give the salient points in the history. The late F. N. Gisborne suggested a cable via Honolulu to Australia in the early seventies, and the Tuscarora, one of the United States navy, surveyed the route in 1874. Cyrus Field took the matter up, and came to England in 1879 with a view to its realization, and about that time Sandford Fleming, C. M. G., became interested in the matter. In 1884 Canada petitioned the home government in the matter, requesting that a survey of the route be made, and even went so far as to offer to pay one-half the expense. The Liberal government of the day refused to budge a step.

At the first colonial conference in 1887 the promoters and opponents were brought face to face, and then Sandford Fleming perfectly annihilated the late Sir John Pender's arguments in opposition. In our opinion neither the latter gentleman nor any of his colleagues should have been permitted to have a voice in the matter, and they never would have been had they not controlled votes in the House of Commons. The questions for the home government were those relating to strategy, to the well-being of the empire, to the possession of an unbroken line of communication, with the principal colonies which touched upon no foreign soil, and could not be tampered with by foreign governments. As we have several times in the history of this controversy stated, Mr. Pender was possibly justified in taking the course he took—first, in opposing the scheme tooth and nail; second, by reducing his tariffs to scotch or kill the contemplated cable; and, third, if he could stop its progress neither way, to carry out the work himself. Of course, by this we mean that the companies he controlled would undertake the work. From his point of view the latter was only to be done as a *dernier ressort*, for it would have increased capital account by a million and a half or two million pounds without any commensurate return from revenue. The cable under his control would have been in quite a different position to the cables under other control. Opposition did not stop the scheme, so a decrease in tariff with arrangement as to subsidies was tried, and for the moment successfully so. The cessation of agitation for this cable from English-speaking centers was the opportunity of the French, who lost no time in making a start, and "in the early part of 1893 actually laid the first section of their cable from Queensland to New Caledonia," receiving a subsidy from two Australian colonies of two thousand pounds a year each for thirty years. No doubt the disgust at the action or want of action of the home government had much to do with the giving of these subsidies. The author of the paper says the "home government, as well as the rest of Australia," adversely criticised this action, but we maintain the home government was out of court because of its own crass stupidity in not assisting to carry out the wishes of the colonies. Adverse criticism should be directed against the home government, not against the colonies. Canada, however, was not to be denied; and, under the able and energetic advocacy of Sandford Fleming, has kept the matter before each successive home government.

Upon the accession of Mr. Chamberlain to office, more attention was directed to colonial requirements, and it is hoped that the whole project may this jubilee year be agreed. We cannot do better than give, in conclusion, one of the paragraphs of the article from *Blackwood's*: "It only remains," says the author, "for the Imperial Parliament to sanction the carrrying out of a project which the colonies have so much at heart. The liability incurred is insignificant. It consists of a third share of a capital of £1,600,000, which Sandford Fleming calculates to be sufficient for the undertaking. The interest on £1,600,000 at 2½ per cent., together with any unforeseen expenses, would not amount to more than £45,000, which, with £30,000 for working expenses, makes a total of £75,000. The surplus of revenue over expenditure for the first three years is estimated at £154,000. The contractor who lays the cable undertakes to keep it in repair for three years; but after that the cost of repairs will have to come out of revenue, so that in the tenth year the total surplus will be £742,000, and the whole £1,600,000 would be paid off in 20 years without costing the taxpayers a single penny. The reduction of the tariff from 4s. 9d. to 3s. 3d. will effect in the first year a gross saving of £190,000 to Australasia and this country. From a strategical point of view the All-British Pacific cable route is of incalculable importance to the empire. The present lines to India and Australia are the following: (1) Lisbon, Gibraltar, Malta, Egypt and Red Sea; (2) France, Italy, Greece, Egypt and Red Sea; (3) Germany, Austria, Turkey, Russia and Persia; (4) Germany, Austria, Turkey, Russia and the Pacific Coast; (5) Lisbon and the West and East Coast of Africa. All these routes pass through foreign countries, and could at once be interrupted in case of war. The Russian journal, the *Novoe Vremya*, recently said: 'In case of an armed conflict between this country and England, our first task would be to block England's communication with India and Australia. With good reason has Lord Wolseley condemned the policy of trusting to the present telegraphic routes to East as nothing less than suicidal."

1. From the London *Electrical Engineer*.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 27.—After listening to all objections, the State Railroad Commission granted the Metropolitan Street Railway company permission to use the trolley conduit system in Fourth, Madison, Sixth and Eighth avenues. The decision provides for 40 miles of street railway, and was announced a week ago. On Thursday application was made to the commissioner of public works for permission to tear up the streets, but, as in the case of the hearing before the state board, the lawyer of the Third Avenue company was on hand to make objection. However, the commissioner said that he did not think a great work like this for the relief of traveling in the city should be postponed for longer than was absolutely necessary. It is said that the work will involve the expenditure of about $5,000,000, and give employment to several thousand men. It is the intention of the company to rush the work at the greatest speed possible, six months only being allowed for the construction of the Sixth and Eighth avenue lines, and for the larger fraction of that time motor cars will be run over a part of the line. For the past year and a half the engineers of the company have been working on the problem, and, as a result, not only are the plans completed for all the work, but much of the material is already in the city, stored in the yards of the company. The plans are to construct the road section by section, employing the maximum number of men in order to do the work quickly. Travel on the roads will, of course, be more or less obstructed, and for a time will be practically suspended. This will be done advisedly to avoid, in the first place, any possible delay in the work of construction. The second consideration is that, with so many parallel lines only a block away, persons will be unwilling to use a line where they will be subjected to long delays.

At the meeting of the aldermen on Tuesday Alderman Tait introduced a resolution compelling the Sixth and Eighth avenue surface roads to file with the comptroller before April 1st a statement of the cost of their lines in order that the city may purchase them at this cost with 10 per cent. added, as provided by their charters. Then Alderman Wund introduced two resolutions, one requesting Gen. Collis not to issue permits to these two roads to disturb the surface of streets in order to introduce electric motive power, and the other directing the corporation counsel to proceed against the two roads for the inforcement of the provisions of their charters, which require them to use nothing but horse power south of Forty-third street in Sixth avenue and south of Fifty-first street in Eighth avenue. The resolutions were referred.

An application has been made to Justice Smyth in the Supreme Court on behalf of the East Chester Electric company for a peremptory writ of mandamus directing the Board of Electrical Control to grant to the company a permit allowing it to erect poles and to string wires for public and private lighting in the Twenty-fourth ward, formerly known as the village of Wakefield. The company alleged that in 1892 it secured a franchise from the village trustees and entered into a contract to light the village. After the district had been merged in the city of New York in 1895, application was made to the Board of Electrical Control for a permit to string overhead wires in order to carry out the contract, but it was refused. Assistant Corporation Council Connoly opposed the motion, arguing that the company's power house was in Mount Vernon, beyond the jurisdiction of the Board. Justice Smyth granted an alternative writ of mandamus, and the issue will come before a jury.

Rapid transit by way of the tunnel is in brightening prospect. The Court of Appeals, by deciding against the *Sun* company in the test suit brought as a taxpayer to restrain the alleged unlawful expenditure of public money, has held the Rapid Transit acts to be constitutional, and thus the last legal obstacle to the work is believed to have been removed. The aldermen and mayor have approved the plans of the Rapid Transit commissioners, and the latter have taken the first step toward the actual award of a contract. Mayor Strong is reported as giving his belief that "real rapid transit is at last in sight," and it may be that he is right.

The Swan Incandescent Electric Light company of 14 White street has applied to the Supreme Court for the voluntary dissolution of the company. The following-named directors united in the application. Mayor W. L. Strong, Edwin Einstein, Emanuel Einstein, David L. Einstein, Charles W. Spear, Morris Tatman, and Felix Samson. The company was incorporated in 1882, with a capital stock of $800,000, to manufacture and sell electric lamps under the patents of Joseph W. Swan. From 1885 until two years ago the manufacture was carried on by a licensee, the Swan Lamp Manufacturing company of Cleveland, O., and the only source of revenue was the royalty. Two years ago the licensee discontinued business, and since then the company has had no income. It was unable to begin the manufacture on its own account now, and as the patents expire this year the directors deemed it advisable to wind up the company. It has no liabilities, and the assets are $6,903 in cash, patents and a safe. M. S.

Western New York.

BUFFALO, March 27.—The negotiations between the manufacturers in the Tonawandas and the Niagara Falls Power company, regarding the amount of electrical power for which the former will contract, are of interest. Among the more extensive plants in the Twin Cities which will utilize electricity from the Falls are the nut and bolt works, Armitage, Herschell & Co., the Buffalo & Niagara Falls Electric Railway company and the Tonawanda & Wheatfield Electric Light company. North Tonawanda is congratulating itself over a scheme which will insure that it receives its power 10 per cent. cheaper than either Buffalo or its companion village on the south side of the canal. At the time of the construction of the transmission line to Buffalo North Tonawanda granted a franchise to the company only on the condition that the village should receive its power at a cheaper rate that this city. Tonawanda will try to secure the reduction granted to its neighbor, but it is doubtful that it will succeed.

The city of Lockport is wrestling with the municipal lighting question. The Lockport Gas & Electric Light company has heretofore furnished the city with light at the rate of $72 per arc lamp. Its contract with the city containing this provision expires April 1st. The company refused to make a new bid at a rate less than $90 a year per light. This aroused great indignation among the residents of Lockport, as the light company has a monopoly in the city. A municipal electric plant was proposed; the city council took the matter up, and a committee was sent to other cities to examine municipal light plants. This committee reported favorably and an enabling bill was drafted for the consideration of the Legislature. J. H. M.

PERSONAL.

Superintendent M. B. Bailey of the electrical department of Buffalo Bill's Wild West show is in New York preparing for the work of the coming season.

Jas. I. Ayer of Boston, G. L. Kimball of Washington, D. C., G. W. Hart of Hartford, Conn., and J. Mustard of Philadelphia, Pa., registered at the New York office of the National Electric Light association last week.

The numerous friends of the contracting parties, especially in the electrical fraternity, will be interested to know of the marriage of C. Clement Hillis to Miss Clara J. Steinhaus on March 22d. The ceremony took place at the Englewood (Chicago) Baptist church. Miss Steinhaus is a handsome young lady, who was one of the trusted employes of the Western Electric company,

while Mr. Hillis has been a long time in the service of the Electric Appliance company, Chicago; in fact Mr. Hillis was one of the earliest employes of the Appliance company.

Henry C. Payne of Milwaukee has determined not to accept an appointment in the diplomatic service. President McKinley offered him his choice of the best foreign missions next to those of England and France. The fact that Mr. Payne declined all offers of office except the one for which he was a candidate, postmaster-general, will strengthen him in Wisconsin. No citizen of that state ever before rejected an ambassadorship nor had a chance to reject the offer of such an office. The same is true as regards other states. The quiet ambition of Mr. Payne to remain in Wisconsin and to seek for political honors at home is greatly to his credit.

ELECTRIC LIGHTING.

Citizens of Jonesboro, Tenn., have organized a stock company for the purpose of erecting an electric light plant.

On April 9th bids for the new city lighting contract in St. Louis will be opened by the Board of Public Improvements. The lighting will commence on January 1, 1900, in the portion of the city north of Keokuk street. The contract calls for both arc and incandescent lamps, and one provision stipulates that the wires used are to be placed underground all over the city. This clause, it is thought, will make the bids unusually high, and many doubts are entertained as to whether any bid will be submitted which will prove satisfactory to the board.

ELECTRIC RAILWAYS.

The receiver of the Englewood & Chicago Electric railway has been authorized to issue $265,000 more of receiver's certificates and a portion of the issue will go to pay for electrical equipment. This makes a total of $325,000 of the certificates.

The judges of the St. Louis County Court held a special session at Clayton, Mo., on March 25th, to hear remonstrances against the petition for a franchise for the construction of an electric railway along the St. Charles Rock road, from the city limits of St. Louis to the Missouri River, opposite St. Charles, with a spur to Creve Coeur Lake. The principal promoters of the enterprise represent the Wellston, Creve Coeur & St. Charles Railway company. The St. Louis County Street Railway company is opposed.

An analysis of the report of the receiver of the Metropolitan West Side Elevated Railway company, which has been filed in the United States Circuit Court, shows that operating expenses for the period covered by the report—January 20th to March 1st—have been within a fraction of 50 per cent. of the gross income. The total receipts from fares during the 11 days of January and the month of March were $86,647.45, which would indicate a total passenger traffic of 1,732,949 and a daily average of 44,434. Divided by months, the February traffic far exceeded the January travel, being considerably over 45,000. The receiver's expenditures are shown to have been $43,938, all of which is chargeable to operating expenses except $5,950, which is a special item paid by order of court. The income from rentals and privileges was $1,048.55 The cash on hand March 1st was $59,215. Should the road continue to make as favorable showing its operation will be at a moderate profit, for its interest charge is $1,369, against average receipts of $1,518. Receiver's reports will hereafter be filed monthly.

The Chicago General Railway company expects to be running its cars as far east on Twenty-second street as Indiana avenue in one month. The lease of the City Railway company's tracks between the river and Indiana avenue, which the City Railway company last January voted to grant to the Chicago General Railway company in settlement of the suits the latter company had pending against it, has not yet been drawn up. The 19 suits are still pending in court and the complainant company will not dismiss them until the City Railway company has fulfilled the terms of its agreement with reference to leases. The officials of the General Railway company are showing almost as much interest in the racing bill now pending at Springfield as are many persons identified with the sporting element. On the success or failure of the measure depends the company's decision regarding an extension of its lines to Hawthorne. If the bill passes the company will establish the Hawthorne branch of its system, and if it is killed it probably will not. The General Railway company's line from Twenty-second street to the stock yards, via Throop and Morgan streets, will probably not be in operation until late in the summer.

TELEGRAPH.

The temporary injunction obtained by a number of firms against the Chicago Board of Trade and the Western Union and Postal Telegraph companies still stands, as Judge Horton has refused to order it dissolved. The injunction restrains the defendants from detaching telegraph wires from the complainants' places of business or from cutting off the supply of market information. The court held that the action of the Board of Trade in allowing market quotations to be distributed all over the country, as has been done by the telegraph companies for a number of years, has rendered this action of public interest. The judge says: "The board has the right to establish proper rules and regulations as to the mode of collecting that news By its conduct it has determined that to permit such telegraph companies so to do is a reasonable and proper regulation, and unless or until some other reasonable regulation shall be adopted by said board said telegraph companies shall be permitted to collect such news and continue the instantaneous dissemination thereof."

MISCELLANEOUS.

The faculty of Purdue University of Lafayette, Ind., has arranged an especial plan of study of railroad engineering. There are 11 courses of study and a series of lectures by railroad men of distinction.

The Peruvian government has decided to establish a permanent exhibition of machinery at Lima. The exhibition will be held in the machinery hall of the exposition palace and will be opened July 28, 1897. Imported articles destined for this exhibition, which are not exempted from duty, will be admitted free of duty through the various custom houses of the country upon the production of a bond guaranteeing the payment of the duties ordinarily levied upon such articles when they are not reshipped within a period of six months. The exhibition of the same article will not be allowed for more than six months without special permission of the Peruvian government.

TRADE NEWS.

Judging by the striking cover of its recently issued catalogue, the Link Belt Machinery company of Chicago has a "cinch" on the world. An athletic young man has taken a turn around the globe with a link belt, and seems to be having things pretty much his own way. The book relates the "Modern Methods" of handling coal and freight to secure speed and efficiency. Many interesting plants are illustrated.

The Arc Welding company of Detroit, Mich., which operates the Coffin system, has opened offices in the American Tract Society building, New York, with T. W. Church, assistant secretary, and W. C. Trageser, assistant treasurer, in charge. These gentlemen go to New York with the best wishes which their high standing in the business warrants, and many friends hope for a repetition of the success that has followed their previous efforts.

It was quite natural that other countries should become interested in the improved system of light successfully introduced in America by Professor Louis B. Marks, the inventor of the "Pioneer" enclosed arc lamp. On invitation of the Societé Internationale des Electriciens, Mr. Marks gladly availed himself of the opportunity to spread the gospel of the new light, and with eminent success his paper was read in Paris on January 20, 1897. It will not be long, it is said, before the boulevards of Paris will have as many "Pioneers" as Broadway, New York.

McLaurin & MacLaren, mica dealers of Brockville, Canada, claim a superior quality for their product. Their mines are situated in the Templeton district, province of Quebec, which has been known for years as a heavier producer of mica than any area of equal size on the continent. The quality has won the favor of some of the largest users, and it is said that the McLaurin & MacLaren mines produce a quality of amber mica superior to any other in the district. Tests demonstrate the high insulating properties of this mica. Some companies prefer to cut their own mica and get it in what is known as the knife-trimmed state. Samples and quotations are sent on request.

Assistant General Manager M L. Livingston of the Standard Thermometer & Electric company of Peabody, Mass., recently returned from a successful business trip through some of the eastern states. He reports that the demand for the new midget enclosed lamp is away beyond expectations, and is looking for good results in the West. Mr. Livingston is one of the live, pushing men of the electrical business. Having formerly occupied a responsible position with the *Northwestern Lumberman* of Chicago, he was conversant with the general territory which he expected to occupy in his new field of operations, and in the short time that he has been identified with it he has demonstrated that his success in this business will be undisputed.

P. F. Olds & Son, engine builders of Lansing, Mich., commenced the manufacture of gasoline engines in a small way in 1885. In ten years' time they had increased their annual capacity of output from 12 to 500 engines, and had distributed their product far and wide. In 1895 the firm brought out the new Olds safety vapor engine. This type is free from cams, gears, worms, rocking arms, levers, lateral shafts, etc., with simple valve mechanism, and is said to be absolutely safe. It met with great success, and in 1896 Olds & Son were obliged, they say, to refuse a large amount of business, being overrun with orders. A large addition to the factory was built and equipped with the most modern machinery to keep up with the demand for an engine said to have no superior in its class anywhere in the country. The firm has just placed on the market a pumping outfit said to operate at a cost of one cent an hour, with a capacity of 600 gallons per hour. Inspection and correspondence are invited.

That the Puritan Arc Lamp company of New York should be obliged to move to larger quarters because of the rapid growth in its business is a pleasing bit of information. General Manager Stewart W. Wise reports that his company has leased larger quarters in the American Tract Society building in New York, being suite 732 and 733, where the enclosed arc lamps can be better seen upon exhibition. The calls for this company's new enclosed arc lamps to be used upon series circuits seem to make it evident that this type meets a definite want in the electrical business. This lamp burns on 6.8 ampere series arc circuits at 70 volts, and gives 2,000 nominal candle power with no resistance, and, therefore, no waste of energy. Arrangements are being made for doubling the present capacity of the works.

BUSINESS.

The Electric Appliance company is making a special "drive" on a lot of floor-glass insulators which it is anxious to dispose of. Users of these insulators will find it to their advantage to get prices from the Electric Appliance company.

The Metropolitan Electric company of Chicago has been given the agency for the Thompson-Brown arc light hanger board. This is one of the best hanger boards on the market, is neat, well built, of good mechanical construction, and a good seller; filling all the requirements of the underwriters, and one that will meet the approval of the best electricians.

V. J. Gillett is in Chicago representing Thomas Muir & Son, 31 Larned street, West Detroit, Mich. This concern, besides manufacturing dynamos, aluminum reflectors, brass and iron conduit, blowers, heaters, etc., is making a specialty of an automatic motor starter which appears to have decided merit. It is an exceedingly simple piece of mechanism, and Mr. Gillett has already met with much encouragement during his stay in Chicago. It would seem that if this device is pushed throughout the West it cannot fail to meet with success.

General Manager C. E. Bennett, Jr., of the Diehl Manufacturing company of Elizabethport, N J, reports that the prospects were never better for their ceiling fans. Inquiries are pouring in on them from all directions, and they are pressed to the utmost to keep up with orders which are at present booked for future delivery. The company has extended its business in exhaust fans, so that anything in this line that is required can be furnished for ventilating churches, halls, theaters, hotels, restaurants, or any places where such class of apparatus can be used to advantage. The fans are especially equipped with a three-speed regulator.

"Color your own lamps by using Crystal chemical coloring," says the Webster Chemical company of St. Paul. The process is simple and practically instantaneous, consisting merely of an immersion of the lamp in a bath of the solution, withdrawing immediately, and drying upon exposure to the air, thus producing a brilliant and durable transparency. "Lamps thus treated will last the full life of the lamp," it is claimed, "retaining their brilliancy permanently. They will not fade. The coloring will keep indefinitely, provided it is kept in the bottle well corked. A dipper or glass bath dish in which to dip the lamp is sent free to each purchaser." A pint of the solution is designed to color 300 lamps. An illuminated circular giving details and testimonials is sent on request.

The electrical equipment of the New York and Brooklyn bridge is proving thus far all that has been claimed for it. It is supervised by Edward R. Knowles, the well-known consulting electrical engineer, with offices in the American Tract Society building, Nassau street, New York. Mr. Knowles has been for several years giving special attention to the various applications of electric power. This he is peculiarly fitted to do, because of his long experience, covering over 15 years, in nearly all the branches of the electrical business. It is not generally known that Mr. Knowles is the inventor of the now well-known Puritan alternating arc lamp, which, all reports indicate, has been a great success from the start. He is also retained as consulting electrical engineer by the Mergenthaler Linotype company, the Arc Welding company and several newspapers.

The new circular on telephones published by Taber & Mayer of 185 Franklin street, Boston, Mass., gives some interesting data in regard to their telephone apparatus of various designs, and especially descriptive of their new desk set, for which they report they are having a very large sale. Quite a large space is given for description of their systems A, B, C, D, which embody secret exchange work, ground work, intercommunicating system, and also an intercommunicating system which is especially desirable for stores, factories, etc. Among the recent purchasers of telephone apparatus they report the following: *Youth's Companion*, United States Rubber company, B. F. Keith's new theater, E. Howard Watch & Clock company, City Hall, B. F. Sturtevant company, Houghton & Dutton, Fitchburg Railroad, Bernstein Electric company, Langham Hotel, Boston; Wakefield Rattan company, Wakefield, Mass.; American Waltham Manufacturing company, Waltham, Mass.; Hotel Wentworth, New Castle, N. H.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued March 23, 1897.

579,124. Electro-plating Hook. John Bossard, Dubuque, Iowa. Application filed April 25, 1896.

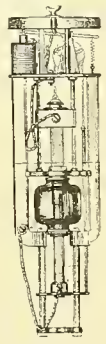
Hooks are provided with means for causing the articles to be revolved while suspended in the bath, and a carrier from which the hooks are suspended for advancing the articles along in the bath.

579,161. Electric Arc Lamp. John A. Mosher, Chicago, Ill. Application filed October 22, 1896.

A pair of vertically aligned apertured cross-bars unite a pair of side posts; a diaphanous arc-enclosing envelope is seated upon the lower cross-bar, and has a pair of carbon-receiving apertures upon its vertical axis and in alignment with the apertures of the cross-bars, and a sleeve is adapted to slide within the aperture of the upper cross-bar and to engage and hold the envelope.

579,168. Sand Box for Electric Cars, etc. Morris M. Nash, Lowell, Mass. Application filed December 30, 1896.

One claim is for the combination with the hopper, the endless band or belt provided with projections constituting buckets and receiving on its upper surface the contents of the hopper, means to support and actuate the band or belt, the plate and the inclined projections on the plate.



NO. 579,161.

579,169. Telegraph Call Bell. Joseph N. Newsom, St. Louis, Mo. Application filed April 27, 1896.

A rocking beam is attached to and operated by the armature of the bell; pawls are pivoted to each end of the beam; a toothed wheel is mounted to be engaged by the pawls, and connections are made between the wheel and the conductor, whereby the operation of the wheel breaks the circuit and thus stops the ringing of the bell.

579,170. Electrically Operated Signal or Semaphore. Joseph N. Newsom, St. Louis, Mo. Application filed September 14, 1896.

Claim is made for a shaft rotatably mounted, a collar loosely mounted upon one end of the shaft, a lever fixed to the collar, a lever fixed to the shaft, signals upon corresponding ends of the levers, connections between the levers and electrically controlled mechanism, whereby the levers are operated in opposite directions.

579,211. Electrical Amalgamator. William Wright, New York, N. Y. Application filed July 8, 1895.

The invention comprises a bed of steel arranged at the upper part of the frame and provided with a pocket, a copper cylinder mounted in the pocket, a second bed of copper in the lower part of the frame and insulated from the steel bed, the bed being provided with a pocket, a steel cylinder mounted in the pocket of the copper bed, the cylinders being of opposite polarity, brushes engaging the shafts of the cylinders, a conductor connecting the brushes, and a generator connected with the beds.

579,213. Device for House Wiring. Herbert R. Young, Lakeport, N. H. Application filed January 31, 1896.

A magnetized body having provision for attachment to a fishing wire and magnetized, and provided at one end with a plurality of hooks.

579,227. Electric Incandescent Lamp. Frank L. Fowler, Philadelphia, Pa. Application filed November 5, 1896.

An incandescent lamp is described, consisting of a globe having an enlargement or beaded portion in its upper extremity, the neck, the middle piece, a filament attached to the latter, a collar having the inwardly turned extremity adapted to engage the portion, a filling or packing of suitable material between the collar and neck, and a threaded base attached to the collar.

579,236. Apparatus for Bleaching Fibrous Materials. Carl Kellner, Vienna, Austria-Hungary. Application filed February 1, 1892. Patented in England April 1, 1890; in France April 1, 1890; in Sweden June 23, 1890; in Norway June 24, 1890; in Germany July 12, 1890, and in Austria-Hungary December 10, 1890.

In an apparatus for bleaching fibrous materials the combination is claimed with a vessel for containing a suitable electrolyte, of electrodes arranged relatively to one another to cause the electric current to follow a zigzag course, and means for bringing the material saturated with the electrolyte into contact with the electrodes.

579,239. Telephone Spring-jack. William O. Meissner, Chicago, Ill. Application filed January 17, 1896.

A circuit-changing device is described, comprising a spring-contact interposed between two stationary contacts, an insulating pin provided at one end with a device adapted to limit its inward movement and at the other end with a conductor adapted to engage the spring-contact when the pin is in a predetermined position, the insulating pin provided with an inclined surface opposed to a V-shaped projection on the spring-contacts, so as to engage the same when the pin is moved to the limit of its inward movement.

579,249. Electrical Gas Cock. Frank W. Ackerman, Corning, N. Y. Application filed July 11, 1896.

An oscillating valve is mounted in a gas regulating cock, and adapted to control the gas supply; an armature is mounted upon the valve, and electro-magnets applied in the casing, so as to exert their force upon the armature at a tangent to its direction of rotation or oscillation.

579,250. Diaphragm for Manufacturing Chlorin and Caustic Soda by Means of Electrolysis. Elbridge Baker, Winchester, Mass. Application filed April 6, 1895.

A diaphragm for electrolytic cells is composed of a body of sand having its grains or particles united by a binder of hydraulic cement less in amount than the body of sand and joining the grains or particles of the sand body at their contiguous edges to form a firm structure, having intergranular spaces constituting pores for the diaphragm.

579,267. Carbon Holder. Charles E. Harthan, Lynn, Mass. Application filed October 14, 1896.

A pair of swinging arms is pivoted at one end to the head of a carbon support for arc lamps, having clamping jaws or heads at their inner ends between which the carbon is to be inserted and held and movable therewith, a ring secured to one of the clamping heads, and a set-screw mounted in the ring and impinging against the opposite clamping head.

579,268. Arc Light Cut-out. Charles E. Harthan, Lynn, Mass. Application filed October 14, 1896.

There are two levers of the first class, each having a rider at its pivotal point, with a roller-bearing edge not conforming to the edge of the adjacent lever, in combination with an actuating part comprising rollers bearing yieldingly against and movable along the levers and the riders to the opposite sides of their fulcrums, and a pivotal lever for operating the rollers, the lever and the rollers having a limited independent play from the lever.

579,273. Zinc for Electric Batteries. Frederic A. Lane, Torrington, Conn. Application filed October 22, 1895.

A zinc for an electric battery has set into its upper end the screw-shank, which is provided with side supports on opposite sides of the zinc.

579,283. Alternating Current Dynamo-electric Machine. Charles P. Steinmetz, Schenectady, N. Y. Application filed March 20, 1896.

A transformer having primary and secondary circuits wound on its main core, a core forming a magnetic shunt to the part of the core on which the secondary is wound, a coil through which a variable current flows wound on the magnetic shunt core, the current variably controlling the number of lines of force diverted from the secondary circuit through the magnetic shunt in inverse ratio to the demands on the secondary circuit.

579,299. Telephone Exchange System. James E. Keelyn, Chicago, Ill., and Kempster B. Miller, Washington, D. C. Application filed April 27, 1896.

The features claimed include divided boards and subscribers' line terminals thereon, an answering and a calling plug connected by a cord-circuit at one of the boards, transfer plugs at one or more other boards, circuits leading from the cord-circuit to each of the transfer plugs, and means whereby any one of the circuits may be connected to the cord-circuit.

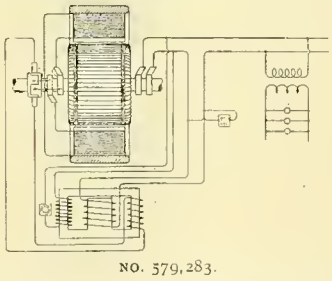
579,300. Electric Railway. Eduard Lachmann, Hamburg, Germany. Application filed June 12, 1895. Patented in Germany April 27, 1895; in Belgium May 14, 1895; in France May 14, 1895; in England May 14, 1895; in Switzerland May 14, 1895; in Italy June 30, 1895; in Austria August 17, 1895; in Hungary August 30, 1895, and in Denmark March 20, 1896.

A main underground conduit is provided with the usual surface slot, and an auxiliary conduit open at its lower end is insertible into the main conduit through the slot.

579,324. Electric Furnace. William S. Hadaway, Jr., New York, N. Y. Application filed May 8, 1896.

The method of generating and uniformly distributing heat over a given surface consists in passing a current of electricity through a mass of conducting fragments placed in close contact, subjecting the glowing mass to the action of a hydrocarbon gas and coincidently combining the carbon element of the gas with the glowing mass, and the hydrogen element thereof with a free gas containing oxygen.

579,344. Electrical Measuring Instrument. Edwin J. Houston and Arthur E. Kennelly, Philadelphia, Pa. Application filed October 27, 1896.



NO. 579,283.

A permanent magnet is provided with pole-pieces, one of which incloses the other, so as to leave between them a polar channel sectorial in the direction of its length about a fixed axis, a coil capable of moving in the polar channel about the fixed axis into positions corresponding to definite and definitely indicated current strengths under the action of electro-magnetic forces and a definite opposing torque or couple.

579,361. Method of Manufacturing Electrodes for Secondary Batteries. Ludwig Epstein, London, England. Application filed September 5, 1896.

The method described consists in first rendering porous the surfaces of lead plates or bodies, then treating them with a mixture of lead oxide and caustic alkali, then drying, and finally converting certain of the plates or bodies into negative electrodes, and others into positive electrodes by immersing them in an electrolyte and connecting them respectively to the negative and positive poles of a source of electricity.

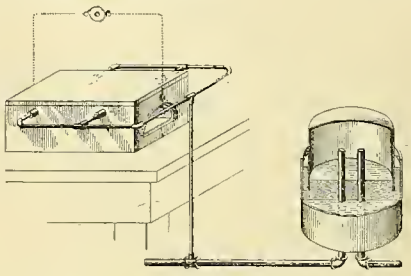
579,366. Circuit Breaker. Frederick C. Robertson, Toronto, Canada. Application filed July 22, 1895.

The details of construction are set forth as follows: A circuit breaker or line-opener, consisting of a fusible wire, a subsidiary circuit to earth and a relay magnet interposed in the circuit between the line wire and the protected instruments, the relay magnet consisting of a magnet frame, a magnet core attached to the magnet frame, a magnet winding on the core in circuit with the line wire and protected instruments, an armature pivotally connected to the magnet frame, an insulated contact point connected to the magnet core tapping the magnet winding, the armature so adjusted that under the normal condition of the current it will be unattracted, but on an abnormal current attempting to circuit through the relay magnet it will be attracted and will impinge on the insulated contact-point and close the subsidiary circuit to earth, a spring for normally keeping the armature from the magnet core, a back-stop to limit the opening movement of the armature, a lightning arrester interposed between the fusible wire and relay magnet, consisting of a clip and a sheet of mica supported by the clip.

579,380. Trolley Support for Electric Railway Cars. Johan F. S. Brantb, New York, N. Y. Application filed November 20, 1888.

A support is mounted upon the car-roof and adapted to have a transverse rocking motion thereon, and a trolley arm is pivoted upon the support on axes perpendicular to each other, one of which is horizontal and transverse to the car.

579,395. Electrical Transformer. Frank H. Jeannin, Arcadia, Fla. Application filed April 1, 1895. Renewed February 15, 1897.



NO. 579,324.

The converter described has a core made up of soft-iron wires all of one length, a separate series of soft-iron wires of various lengths, and a magnetic circuit formed by the varied lengths of soft-iron wires placed between the layers of copper wire composing the primary and secondary coils, and the projecting ends of the wires between the layers next adjacent the core being bent inward across the end of the core, and the others being bent outward and lapped over each other, and an exterior casing for holding in position such lapped-over portions.

579,431. Automatic Electro-magnetic Circuit Breaker. Walter E. Harrington, Philadelphia, Pa. Application filed May 5, 1896.

In an electro-magnetic circuit breaker the combination with a switch of two cores and a solenoid coil, the cores movable in the magnetic field of the coil and adapted to be actuated by the current passing through the coil to actuate the switch, with movable counter-balance as a means of adjustment with respect to minimum amount of current or voltage necessary for its actuation.

579,473. Electric Time Check and Recorder. Alexander Davidson, New York, N. Y., and Charles G. Armstrong, Chicago, Ill. Application filed January 25, 1896.

A ticket-selling device, comprising a set of annunciators, ticket-holders controlling the same, synchronized clocks and commutators with batteries and circuit wires are arranged to indicate automatically to a remote station the sale of any ticket at the selling station, in combination with a device for detecting a lack of synchronism in the clocks.

579,482. Telephonic Messenger Service. Jefferson D. Hobbs, New York, N. Y. Application filed February 18, 1896.

In this arrangement there is in a telephonic messenger service the combination of a circuit having two or more ground wires, a battery, a drop or other indicator, and a device for adding or cutting out one of the ground wires located in the circuit between the latter, the device normally cutting out the wire, a telephone receiver and a transmitter placed in the circuit and normally cut out of the same by a short circuit, a contact-piece and key placed in the circuit in a position whereby upon depressing or moving the key from the contact-piece the telephone receiver and transmitter will be brought into the circuit, a second telephone receiver and transmitter, and means for placing the latter in the circuit to close the same metallically and cut out the drop and second ground wire, the one battery being placed in the circuit for supplying the several parts of the system.

579,511. Electrically Operated Sewing Machine. John S. Biggar, Chicago, Ill. Application filed January 8, 1896.

Claim is made for the combination of a needle-holder, a pair of solenoids adapted to reciprocate the same, a rotary shuttle with a shaft upon which the shuttle is mounted, a circuit-controlling switch adapted to control the circuits through the solenoids, and a motor contained within the frame or standard of the machine adapted to rotate the shaft and the shuttle and switch mounted thereon.

579,525. System of Circuits and Apparatus for Electric Railways. George Westinghouse, Jr., Pittsburg, Pa. Application filed August 20, 1891.

There is the combination with an electrically operated car, of an electro-magnet moving with the car, consisting of magnetic wheels or contacts electrically insulated from each other, a magnetic core for the same, coils wound upon the core, insulated sectional magnetic contact rails for the contacts, an insulated supply conductor and a magnetic circuit-closing device for completing the connections between the supply conductor and the sectional conductors, comprising an iron box made in two parts insulated from each other, and a movable armature actuated by the electro-magnet.

579,526. Electro-pneumatic Locomotive. George Westinghouse, Jr., Pittsburg, Pa. Application filed March 4, 1892.

The combination is claimed with an electric motor, of a vehicle driven thereby, an air compressor, a supplemental electric motor for driving the air compressor, a compressed air reservoir and a fluid motor for assisting in driving the vehicle operated by air under pressure from the reservoir.

579,527. Electric Railway System. George Westinghouse, Jr., Pittsburg, Pa. Application filed February 19, 1894.

A street railway built with flat rails on one side constituting electric supply and return conductors, and grooved supporting and guiding rails on the other side.

Western Electrician.
EVERY SATURDAY.
Vol. XX. CHICAGO, APRIL 10, 1897. No. 15

Electric Heating of Niagara Falls Power Station.

By Orrin E. Dunlap.

The Niagara Falls Power company's big power station offers one of the most interesting studies on the subject of electrical heating to be found in the United States, if not in the world. This power station is a beautiful structure built of Queenston limestone. It is of the Moorish style of architecture and stands on the west side of the inlet canal over the deep wheel-pit. Its present dimensions are: Length, 195 feet; width, 60 feet; height, about 50 feet. As the wheel-pit is being extended, and the power house will cover the extension, the dimensions here given will be soon materially increased, but the facts related have to do with the power station as it stands to-day. The fact that the roof of the great building is free from and unbroken by chimneys excites the attention of approaching visitors, and many are at a loss to know how to account for the unusual appearance of the structure on its exterior until they get inside and realize that the pleasing warmth is due to electrical heat, and that no other heat is employed about the building. It is then that they begin to comprehend the immensity of the Niagara power development as portrayed by this wonderful plant, and grasp the idea that the atmosphere of the power house is warmed by the derived and transformed energy of the water of the Niagara River, which gives motion to the dynamos.

The power house is divided into the dynamo room and the office quarters—a fact which makes necessary two series of heaters. One style of heater is used in the office portion of the building and another kind is used in the dynamo room. The heaters in the offices are on a secondary 100 volt circuit, and this circuit is fed through converters which reduce the voltage from 2,000 to 100. This low voltage is adopted for office heating purposes on account of the danger there would be in the use of a high potential circuit through the offices. In the office portion of the power house there is about 175 horse power in heaters of the "American" pattern, but they are seldom all in use at the same time, as all the rooms are not kept at a living temperature. Of course, it depends entirely upon the weather conditions as to the amount of heat required to make the rooms comfortable. The office occupied by Electrical Superintendent Paul M. Lincoln is about 20 by 15, by 9 or 10 feet high. In this room are two heaters, each of seven horse power, making a total in the room of 14 horse power, and in zero weather both are necessary to give comfort.

The method employed in heating the dynamo room is entirely different from that in use in the office portion of the building. In this room there are 15 heaters on three circuits of five each, and each circuit takes up about 200 horse power. However, it has never yet been found necessary to use all three circuits, two of them being found sufficient in the coldest weather. By consulting the illustration on this page the heaters will be seen on the walls of the dynamo room about 15 feet above the floor. This method of placing them was adopted partly as a means of safety, but it serves nicely in distributing the heat midway between the roof and the floor. The current for heating the dynamo room is taken from the bus-bars and carried on No. 4 rubber-covered wire, while that for heating the office portion of the building is taken from the primary of the circuit which feeds the street railways about Niagara Falls. As each heater takes up about 40 horse power, it will be seen that to put in transformers to convert the power down to 100 volts would be quite expensive, and consequently the current is taken direct from the 2,200 volt circuit.

The heaters in the dynamo room are made of two circular rolled iron plates which are about one-eighth of an inch thick and 24 inches in diameter. Bolts hold these plates parallel, about four feet apart, one above the other. Each plate has about 28 holes in it, and the diameter of each hole is about one-half inch. In each of these holes is placed a porcelain insulator having a

ELECTRIC HEATING OF NIAGARA FALLS POWER STATION.—DYNAMO ROOM WITH HEATERS PLACED ON WALLS.

pretty large head, and through the insulators No. 6 iron wire is strung. There are 38 coils, and each coil is about an inch and a half in diameter, the distance between convolutions being about twice the diameter of the wire; at least it is such that the heaters will take about 65 amperes at 440 volts, so that each five heaters in series will consume 2,200 volts at 65 amperes. The heaters were designed by Paul M. Lincoln, electrical superintendent of the Niagara Falls Power company, and made by Dobbie, Stuart & Co. of Niagara Falls. Heaters of very similar pattern are in use in the power station of the Niagara Falls Park & River Railway company in Queen Victoria Park on the Canada side of the river, the voltage on the latter heaters being 500.

The maximum amount of power used in heating the dynamo room and office portion of the central station of the Niagara Falls Power company is about 420 or 430 horse power, but it must be understood that this is not counting the heat from the dynamos, which is, indeed, an important factor so far as the dynamo room is concerned. At the present time there are three dynamos in the station, each of 5,000 horse power capacity. As a general thing two of these machines are running at the same time. Now if each machine was being run so as to give 4,000 horse power, instead of at its full capacity, and three per cent. of this power was lost in heat, each of the dynamos would contribute no less than 120 horse power to heating the dynamo room, or from the two machines generally in use 240 horse power would be obtained. This estimate of the power from the dynamos lost in heat is not any too large, a fair average being from 2½ to 4½ per cent. Add the 240 horse power from the dynamos to the amount of power consumed by the heaters when all are in service, and it will be seen that nearly 700 horse power is consumed in heat in the entire building. It is fair, however, to state that when two dynamos are in operation the additional heat they throw off makes unnecessary the use of all the heaters, and with three dynamos in operation more heat would be thrown into the dynamo room. The heaters in use in the power house have been found very serviceable.

Chicago Electrical Association.

The next meeting of the Chicago Electrical association will be held Friday evening, April 16th, at 1737 Monadnock building. The feature of the meeting will be the reading of a paper by C. Wiler on "Arc Lighting in America and Europe," which will be followed by a discussion in which several experienced central station men have promised to participate.

The Frictional and Electrical Process for Shaping, Hardening and Finishing Metallic Surfaces, as Applied in the Sibbald Railway Wheel Dressing Machine.[1]

In this process a revolving steel disk designed to stand high centrifugal strains is given a peripheral velocity of say 33,000 feet per minute, against which the carriage wheel or other object to be dressed is slowly revolved, enough pressure being applied to cause frictional resistance sufficient to consume power transmitted to the disk, and convert it into heat. The disk cuts or rubs off the heated metal, leaving a smooth hard surface. The hardening effect depends upon the percentage of carbon in the metal being worked and the manner of handling during operation, varying with these conditions from $\frac{1}{100}$ inch to $\frac{1}{16}$ inch in depth.

It has long been known that a rapidly revolving disk of soft iron would heat and cut its way through iron and steel without injury to itself. Little practical use was made of this principle, however, although in use to some extent for cutting railway rails, tubing and merchant bars and other special purposes.

The reason why the disk cuts metal harder and tougher than itself is apparent when the operation is analyzed. The mechanical equivalent of heat as demonstrated by Dr. Joule and others equals about 42 units of heat per horse power per minute, thus giving at the periphery of disk a heating effect directly in proportion to the horse power applied, as all the net power delivered to disk is converted into heat by frictional resistance and disturbance of metal under operation. As the power is consumed and the heat generated where the disturbance of metal under operation takes place, it follows that a greater part of the heat is generated in the metal being removed. The disk being kept cool by conduction and radiation into the atmosphere, or by application of water, its surface is not disturbed, and consequently very little heat is generated within the disk.

The high velocity of the disk, viz., 33,000 feet per minute, requires only one pound frictional resistance to the movement of the disk per horse power applied. Thus in the consumption of 100 horse power, 100 pounds frictional resistance to the movement of the disk is given. This, distributed over the surface of contact between the metal under operation and disk, which exceeds one square inch at all times, is not sufficient to abrade or injure the surface of the disk. With 100 net horse power, we have a total heating capacity of 4,200 calories or English units of heat per minute, equal to raising the temperature of 4,200 pounds of water one degree Fahrenheit, and as the specific heat of steel is 0.12, it follows that this horse power will raise the temperature of 35,000 pounds of steel one degree; this equals 14 pounds heated to 2,500 degrees, the temperature to which steel is heated in removal by this process.

The percentage of the total heat, equivalent to net power delivered to disk, utilized in actual work, is indicated in the last column in the accompanying report of test made at Erith Iron Works, April 6, 1892.

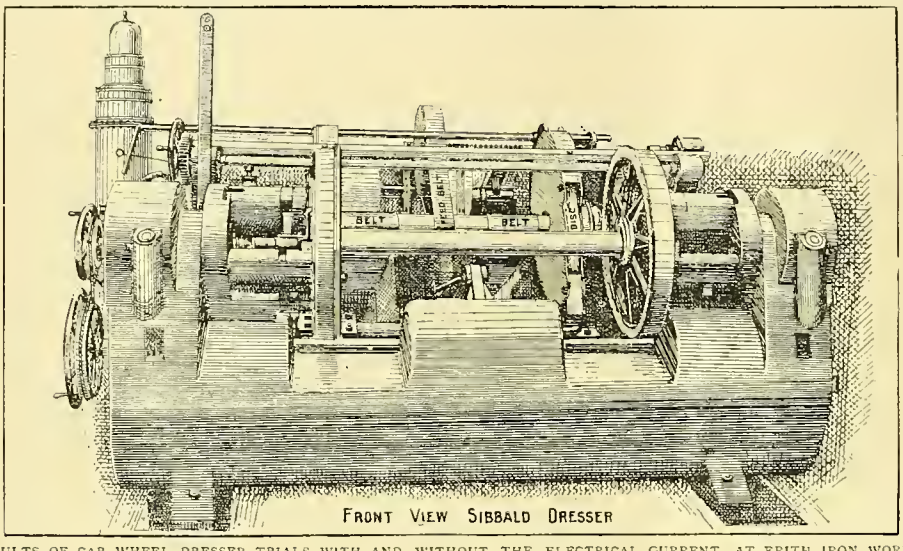
It is indicated by experiments at the Erith Iron Works and elsewhere, that a greater heating efficiency can be got from the electrical current applied at points of contact between heating disk and object being dressed than from the power frictionally consumed, and that considerable saving can be made by applying a large percentage of the power electrically, sufficient power only being applied to the disk to remove the metal heated by the electrical current. The effect of the current upon disk is not destructive owing to the distribution over its whole peripheral surface, and as current is passed through the heated spot in the metal under operation, where the greatest resistance takes place, owing to high temperature and small surface, we consume most of the current within the body of the metal being removed, consequently the higher percentage of efficiency. The current applied in very small quantities appears to greatly increase the coefficient of friction, and thus less pressure between surfaces is required to consume the power and generate its equivalent in heat; consequently a gain is made in reduced frictional resistance throughout the journal bearings of machine, in addition to the heating effect of current.

The gain in mileage life of car wheel tires hardened by this process over those in ordinary condition (as indicated by the greatly reduced wear of tires dressed by this process and the increased durability of chilled iron wheels over those of soft iron) must be great, and if the advantages of this process are fully utilized by redressing soon after the hardened surface is worn off, the mileage life of tires will be at least doubled. The cost of dressing when only sufficient metal is removed to reproduce the hardened surface will be considerably less than is shown in the report of tests made April 6, 1892, at Erith Iron Works.

In addition to the dressing of railway wheel tires, the process is peculiarly well suited to the finishing and hardening of journal surfaces in all classes of machinery where journals are subjected to considerable pressure and speed. The journals of railway axles are reodered very much more durable, and will give proportionately less trouble when dressed and hardened by this process.

It is only necessary in dressing journals to remove a small amount of stock, $\frac{1}{32}$ of an inch being quite sufficient to harden surface, and this does not distort or spring the journal, as is the case where journals or spindles are case-hardened or tempered throughout, although the surface produced by this process is much harder, more dense and in every way more perfect than is possible to get from any other method of hardening. Milling rolls of suitable steel (which may be softly annealed if desired) may be dressed, and a surface produced much harder and more durable than that of chilled iron; rolls of chilled iron can also be most economically dressed by this process, when electrical current is used to increase friction, and heat metal being removed. The expense of hardening journals by this process is slight, as very little metal is removed.

The report of car-wheel dresser trials, with and without the electrical current, is entirely based upon observations and data made by two competent experts, acting quite independently of each other in taking observations, and indicator cards alternately throughout the trial. The reports from each expert were made independently, the result showing only a very slight percentage of difference between the two. The conclusions in footnote of report are entirely based upon actual results attained during these trials; and as a trial machine is very imperfect in many essential points, it is expected that a much higher percentage of efficiency can be attained with the proposed new machine, although this is not assumed or indicated in the report.



RESULTS OF CAR WHEEL DRESSER TRIALS WITH AND WITHOUT THE ELECTRICAL CURRENT, AT ERITH IRON WORKS, ERITH, KENT, APRIL 6, 1892.

Condition of Trial.	I. H. P. Total.	I. H. P. Net, Including 2 E. H. P. for Current.	Reduction in Net I. H. P. over mean of Nos. 5 and 6, by Using Electrical Current.	Steel Removed per 100 I. H. P. per Minute. Cubic inches.	Steel Removed per 100 I. H. P. per Minute. Pounds.	Efficiency of Machine. See Note.	Remarks.
1 Engine only	27.56			Nil	Nil		3,168 Rev. per min.
2 Engine driving disks	67.36			Nil	Nil		3,276 " " " Running light.
3 With current	104.86	39.5	24%	10.92	3.00	21.4%	3,150 " " " Cut ⅛" deep traverse 3" per min.
4 Ditto	Mean 110.66	45.35	13%	9.35	2.61	18.6%	3,123 " " " Diameter of wheel, 36".
5 Without current	119.57	52.21		8.11	2.27	16.2%	3,141 " " " Same feed as in 3 and 4.
6 Ditto							3,132 " " "

NOTE.—The efficiency of the machine indicates the percentage of work equivalent to the heat generated at disk to the net horse power delivered to the disk.

With proposed new machine and engine indicating 166 H. P. = say 100 I. H. P. net, six wheels per hour could be dressed, removing 16 pounds from each. Allowing 40 per cent. of total time for handling wheels, etc., the mean I. H. P. with machine at constant work being 125, and the estimated cost per wheel, including 1½ pounds coal per I. H. P. per hour, fireman 25s., machine attendant 35s. per week each, and interest and depreciation on plant of £90 per annum, being 5¼d. per wheel.

1. Canadian Society of Civil Engineers.

E. G. Willyoung to Lecture at the University of Nebraska.

Prof. R. B. Owens of the Department of Electrical and Steam Engineering of the University of Nebraska at Lincoln, Neb., has arranged for another course of electrical lectures by a specialist for the benefit of his students and of such outside engineers as can find it convenient to attend. As the readers of the WESTERN ELECTRICIAN are aware, Mr. Arnold's lectures of last month on the "Design and Construction of Electric Power Plants" (now appearing serially in this journal) were entirely successful and greatly appreciated by all who heard them. The second series will be delivered by Elmer G. Willyoung of Philadelphia, beginning on April 19th, and his subject will be "Electrical Measuring Instruments," discussed in ten lectures. Mr. Willyoung is very well equipped to lecture on the subject announced, and the course cannot fail to be a valuable one. Prof. Owens holds, and rightly, that in no better way can students be brought to appreciate correct methods of current practice than by means of such lectures, delivered by well-known and successful engineers, fresh from the field of their practical labors.

On April 29th the town board of Irvington, Ind., will take up the question of lighting the town by electricity. Propositions and specifications are invited, particularly with a view to the construction of a plant which at the end of 10 years shall become the property of the town. Such a plant must offer facilities for arc and incandescent lights and for power. Other plans, however, may be submitted

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part II.

Cost of the Production of Power.

As was remarked in the opening lecture, the cost of the production of electrical energy depends upon the following factors:

First—Cost of raw material in the form of fuel and water.

Second—Cost of supplies.

Third—Cost of labor.

Fourth—Interest on capital invested.

Fifth—Depreciation of plant.

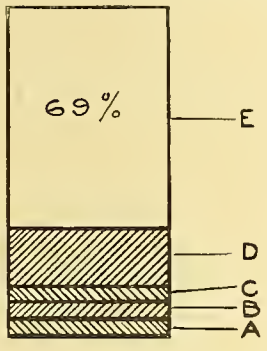
The relative importance of these different factors will of course vary with each particular case and depends partly upon the design of the power station and partly upon surrounding conditions. In so far as the results depend upon the predetermined plan of the plant, we are interested. It will be of interest to examine the records of a number of plants in actual operation.

Table I., taken from figures prepared by Mr. A. V. Abbott, shows the relation of the various cost factors in the production of electrical power in a number of lighting plants of moderate size:

Table I.

Location.	Capacity of Plant in Kilowatts.	Per cent. of Total Cost.				
		Labor and Superintendence.	Fuel.	Oil and Supplies.	Interest.	Depreciation.
Bay City, Mich.	87.0	21.0	14.5	25.2	15.0	24.3
Dunkirk, N. Y.	50.4	13.8	18.2	19.2	20.0	28.8
Easton, Pa.	64.8	16.6	20.6	19.0	16.6	27.2
Elgin, Ill	60.0	30.2	17.0	16.9	13.5	22.4
Little Rock, Ark.	69.6	30.1	15.8	12.8	15.5	25.8
Quakertown, Pa.	56.2	20.4	14.3	30.3	13.1	21.9
West Troy, N. Y.	49.4	24.2	26.0	9.5	15.2	25.0
Aurora, Ill.	120.0	32.2	18.8	5.6	16.2	27.2
Galveston, Tex.	122.4	32.0	15.8	24.6	10.3	17.3
Hannibal, Mo.	222.0	21.1	10.5	16.3	19.6	32.5

The following table presents the average result of the



Heat lost by radiation	5 per cent.	(*A*)
" " incomplete combustion	5 "	(*B*)
" " evaporating moisture in coal	3 "	(*C*)
" " in chimney	18 "	(*D*)
Efficiency of boiler	69 "	(*E*)
	100	

FIG. 3. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—EFFICIENCY OF BOILER.

operating expenses of a number of large direct current central lighting stations not given in Table I.:

Table II.

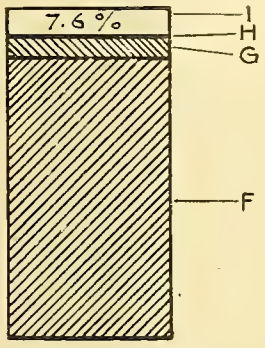
Fuel	23.15 per cent.
Labor	21.2 " "
Lamps	7.75 " "
Repairs	13.10 " "
General expenses	23.15 " "
Other expenses	11.65 " "
Total	100.00

Table III. shows the relation between the cost factors in two large electric railway power plants of about the same capacity, plant A being the highest type of a simple engine non-condensing plant, while plant B is one of the most modern types of compound condensing stations, both operating on the same kind of fuel; plant A buys its water, while plant B pumps it from a stream some distance away.

Table III.

Factors of cost.	Plant A.	Plant B.
Fuel	44.9 per cent.	32.6 per cent.
Water	2.9 per cent.	.8 per cent.
Labor	20.1 per cent.	20.6 per cent.
Supplies and repairs.	2.0 per cent.	7.2 per cent.
Interest	16.5 per cent.	21.2 per cent.
Depreciation	13.6 per cent.	17.6 per cent.
Total	100.00 -	100.00

The object of the power station designer is, of course, to produce a kilowatt-hour upon the switchboard at the smallest possible total cost with everything considered, and it is extremely important in laying out a plant that the relation to one another of the different cost factors be borne constantly in mind. If the engineer in each case had simply the problem of the highest fuel economy to solve, he would find the question to be a comparatively easy one, but, as we see, the reduction of the total cost of the electrical energy produced involves a consideration of five factors intimately connected. Cutting down the labor account, for instance, may increase the amount of coal used, affect the economy in the use of supplies, or increase the annual fixed charges on account of an extra investment in labor-saving devices. Buying a cheaper grade of coal may reduce the cost of fuel, but at the same time entail a correspondingly greater increase in the labor account. In designing a power plant it is quite necessary to keep in mind that certain appliances, though perhaps economical in themselves, may,



Theoretical loss from the second law of thermo-dynamics	84.25 per cent.	(*F*)
Loss by radiation, condensation and leakage	7.30 "	(*G*)
Loss due to engine friction	.85 "	(*H*)
Efficiency of engine	7.60 "	(*I*)
	100	

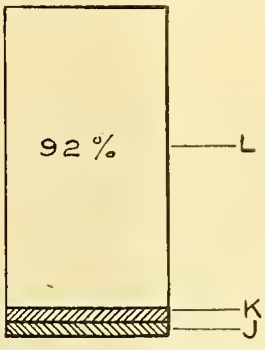
FIG. 4. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—EFFICIENCY OF ENGINE.

under a certain set of conditions, entail expenses which will make their use unadvisable. The engineer should take a broad view of the situation in each particular case, and never lose sight of his purpose to produce a kilowatt-hour as cheaply as the given conditions will allow.

In the design and operation of power plants the engineer is naturally interested in what is usually termed the "coal pile," and it is important that he should be conversant with all devices and economical appliances or arrangements which will decrease the consumption of fuel. It will be of value, therefore, to trace in a general way the energy of the coal from the furnace door to the switchboard. Let us start first with the

Economy of the Boiler.—Of the amount of heat generated by the combustion of the fuel in the furnace a certain percentage will be utilized in heating the water and generating steam. This percentage is the efficiency of the boiler, with everything considered.

The heating value of anthracite coal per pound of combustible may be taken as 14,500 British thermal units. As it takes 966 heat units to evaporate one pound of water into steam from and at 212°, one pound of combustible should theoretically evaporate $(\frac{14500}{966})$ about 15 pounds of water. This assumes an efficiency of 100 per cent. Now, in actual practice what efficiency is it reasonable to expect? Engineers are accustomed to efficiencies ranging somewhat above 90 for electric generators, but a little consideration will show the unreasonableness of expecting such a good performance of the boiler. With the present



Friction losses	4 per cent.	(*J*)
Electrical losses	4 "	(*K*)
Efficiency of generator	92 "	(*L*)
	100	

FIG. 5. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—EFFICIENCY OF GENERATOR.

method of boiler construction there are certain unavoidable wastes which place a limitation upon efficiency. These may be enumerated as follows:

First—Loss due to the heat required to raise flue gases to temperature necessary to produce draft.

Second—Loss due to heat required to evaporate moisture in coal.

Third—Loss due to radiation and conduction.

Fourth—Loss due to incomplete combustion and loss of coal through the grates.

The sum of these different wastes will be the difference between the efficiency obtained by a test upon the boiler and 100 per cent.

The heat units lost in the chimney gases may be calculated by comparing the temperature of the gases o combustion before and after passing over the heating surfaces. Assume, for this purpose, that all the heat units of the fuel pass into the gases. For every pound of combustible allow 24 pounds of air for complete combustion. This will give, then, 25 pounds of gases for each pound of combustible. The specific heat of the gases may be taken at .234. If t is the temperature of the gases, we have the formula

$$14500 = 25 \times .234 \times t.$$

from which

$$t = \frac{14500}{25 \times .234} = 2400^\circ \text{ F. nearly.}$$

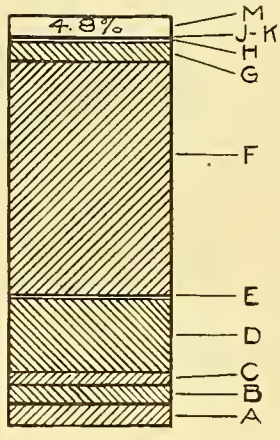
If the temperature of the surrounding atmosphere is taken at 62° and the temperature of the flue gases in the chimney be ascertained to be 500°, the loss of heat in the chimney will be:

$$\frac{500^\circ - 62^\circ}{2400}$$

or about 18 per cent. of the original heating value of the coal.

The other losses in the boiler depend somewhat upon circumstances, but for our purpose we will not be far out of the way if we assume three per cent. of the total heat generated required to evaporate the moisture in the coal, five per cent. as the amount of heat lost by radiation and conduction through the housing of the furnace, and five per cent. as the percentage lost by incomplete combustion, loss of fuel through the grates and in other ways. The sum total of these losses will be seen to be 31 per cent., leaving the boiler efficiency as 69 per cent. The efficiency of the boiler and the corresponding losses are shown graphically in Fig. 3.

Theoretically we found it possible to evaporate 15 pounds of water per pound of combustible. Sixty-nine per cent. efficiency will give a probable evaporation of 10 35 pounds of water from and at 212° Fahrenheit. This figure agrees very well with the average results obtained in numerous tests, and represents fair practice. Occasionally better performance than 10.35 pounds is obtained, but it is usually upon a special test under combinations of very favorable circumstances. More often, boilers in every-day service will show an evaporation of eight or nine pounds per pound of combustible, and this is especially true in electric power stations, where the load is more or less variable. The performance of the boiler is controlled to a certain extent by the type. The conditions for the best economy, however, in the furnace, boiler and chimney, will be treated under these separate headings, it being the intention at this point to show the relative importance of economy in the different parts of the plant.



	Per cent.	Heat Units.	
Loss by radiation	5	725	(*A*)
Loss by incomplete combustion	5	725	(*B*)
Loss by evaporation of moisture	3	435	(*C*)
Loss in chimney gases	18	2,610	(*D*)
Loss by pipe condensation	1	145	(*E*)
Theoretical loss in engine	57.2	8,294	(*F*)
Loss by condensation and radiation	5	725	(*G*)
Friction losses in engine	.6	87	(*H*)
Losses in generator	.4	58	(*J-K*)
Energy available at switchboard	4.8	696	(*M*)
Total	100	14,500	

FIG. 6. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—COMBINED EFFICIENCIES OF BOILER, ENGINE AND GENERATOR.

Engine Efficiency.—In tracing the energy from the fuel to the wattmeter the greatest loss will be found to occur in the steam engine, which is the most uneconomical device in the chain of transformation. With steam at 100 pounds gauge pressure, a good non-condensing simple engine will require about 30 pounds of steam per indicated horse power per hour. From our steam table we find that steam at a pressure of 115 pounds (absolute) contains 1,185 heat units per pound above 32 degrees or 1,004 heat units above 212 degrees. The amount of heat units per horse power per minute used by the engine then becomes

$$\frac{30 \times 1004}{60} = 502 \text{ heat units.}$$

Now one foot-pound of energy equals $\frac{1}{778}$ heat unit, so that 33,000 foot pounds per minute, or one horse power minute, is equivalent to $\frac{33000}{778}$, or 42.416 heat units per minute, which is the amount of heat theoretically necessary to develop one horse power for one min-

ute. But our engine uses 502 heat units per indicated horse power; therefore its efficiency is found to be practically $\frac{42.416}{502}$, or 8.45 per cent.

The highest possible theoretical efficiency of such an engine, from the second law of thermo-dynamics, is

$$E = \frac{T_1 - T_2}{T_1}$$

Consulting the steam table, we find that steam at 100 pounds gauge has a temperature of 337.8 degrees Fahrenheit. Therefore

$$E = \frac{337.8 + 461 - 212 + 461}{337.8 + 461} \text{ or } 15.75 \text{ per cent.}$$

This would be the result if the engine operated with no heat losses whatever. The difference then between the efficiency obtained in practice, 8.45 per cent., and the maximum possible theoretical efficiency, 15.75 per cent., or 7.3 per cent., is to be charged to losses due to condensation in the cylinders, to leakage and to radiation. Of the original number of heat units delivered to the engine, then, 8.45 per cent. are converted into energy of mechanical motion. About one-tenth of this 8.45 per cent., or .845 per cent., is required to overcome the friction of the engine, reducing the commercial efficiency to 7.605 per cent. This, it will be understood, is with a simple non-condensing engine using steam at 100 pounds pressure. With a jacketed triple-expansion condensing engine working at 200 pounds pressure, it is possible to raise this efficiency to perhaps 18 per cent., which about represents the limits which have been reached in practice up to the present time. It is probable that advances will be made in the near future along the lines of higher steam pressures, working through four expansions, but, as before stated, the intention at this point is simply to indicate relative economies as actually existing. The engine losses are shown graphically in Fig. 4 (page 201).

Efficiency of Generator.—Considering relative efficiency, the most satisfactory transformation of the energy on its way to the switchboard is that which occurs in the generator, which is capable of a commercial efficiency of 92 per cent. or better, the losses being about equally divided between those due to internal electrical actions and reactions and those due to mechanical friction. There is little room left for improvement in the commercial efficiency of the generator, and it is to be regretted that it should be the last transforming device in the series, where its high efficiency makes so little difference in the cost per kilowatt-hour. The generator losses are shown graphically in Fig. 5.

Combined Efficiencies.—Starting now with a pound of coal, containing 14,500 heat units, it will be instructive to combine the various efficiencies, to determine the amount of energy which finally reaches the switchboard. This result is shown graphically in Fig. 6.

$$\text{As one watt-hour} = \frac{33000 \times 60}{778 \times 746} \text{ or .293 British thermal}$$

unit, the result of 696 heat units reduced to watt-hours becomes 204, or for every pound of coal burnt per hour 217 watt-hours will be produced. This corresponds to .27 horse power hour to a pound of coal, or one horse power hour delivered from the switchboard for every 3.7 pounds of coal. This result agrees very well with what is found in the average practice in moderate sized plants.

An examination of the diagrams (Figs. 3, 4 and 5) shows that the greatest loss by far occurs in the steam engine. It is of course understood that with much higher steam pressures and a greater number of expansions this loss can be reduced. It may be interesting to recalculate the heat losses upon an assumption of the highest possible economy in the engine, assuming at the the same time a better efficiency for the boiler. Taking as a basis

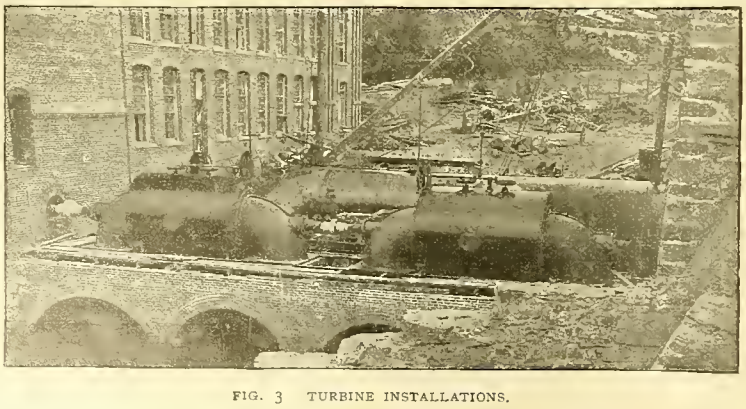


FIG. 3 TURBINE INSTALLATIONS.

a consumption of 11 pounds of water per horse power hour at a steam pressure of 200 pounds and a vacuum of 28 inches, the amount of heat units per horse power per minute used by the engine becomes

$$\frac{11 \times 1019}{60}$$

or 186 heat units. One horse power was shown to be equivalent to 42.416 heat units per minute, and therefore the efficiency of our engine in this case becomes

$$\frac{42.416}{186} \text{ or } 22.7 \text{ per cent.}$$

The highest possible theoretical efficiency of the engine in this case becomes

$$E = \frac{387.7 + 461 - 100 + 461}{387 + 461} = \frac{287.7}{848} = 32.7 \text{ per cent.}$$

and, as before, the difference between 32.7 per cent., the theoretical efficiency, and 22.7 per cent., the actual efficiency, leaves 10 per cent. lost in condensation and

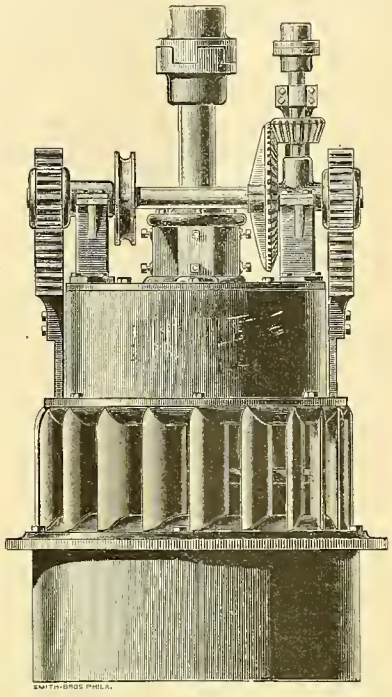


FIG. 1. TURBINE INSTALLATIONS.

radiation. Revising our table of losses (Fig. 6) on this basis, we have:

Revised Table of Heat Losses.

	Per cent.	Loss in heat units.
Loss in boiler and chimney on basis of 11 pounds water per pound of coal	26.0	3,770
Piping loss on same basis	1.0	145
Unavoidable loss in engine	41.8	6,061
Radiation, conduction, condensation and leakage	7.3	1,059
Engine friction	2.4	348
Losses in generator and leads to switchboard	1.9	275
Available electrical energy	19.6	2,842
	100.0	14,500

This result gives us 19.6 per cent. of the energy of the fuel available at the switchboard end of the line, as compared with only 4.8 per cent. obtained in the first proposition, where a simple engine was considered. It probably represents about the highest obtainable limit to be reached with an expansion engine. The result is equivalent to the production of an electrical horse power hour by a consumption of but .9 pound of pure carbon—a result that has never been approached in practice. It gives us an idea, however, of what may some day be attained, and may serve as an incentive for the best efforts of the power station designer.

It has been assumed that one pound of coal contained originally 14,500 British thermal units of heat. This value in reality is the number of heat units in one pound of pure carbon. The more impurities there are in the coal the less will be its heating power per pound, which leads us to consider the question of the

Selection of the Fuel.—Fuels used in the power stations of this country may be classed as petroleum, natural gas, artificial gas, wood and coal.

Petroleum.—This fuel, which is a natural liquid product, has been very extensively introduced of late years, but it is very doubtful if its use is ever justified by a saving in the actual cost of evaporation. Its cleanliness and extreme convenience in handling make it a very desirable fuel, however, in many cases (World's Fair plant, for instance). It is difficult with petroleum to obtain an even distribution of the heat, and the boiler is very liable to be injured by the hot flame from the oil burner.

Natural Gas in many localities will prove the cheapest fuel. It is an ideal fuel, considering the cleanliness of the boiler room and the ease and convenience of handling. Its disadvantages, however, are its explosiveness and the fact that the natural supply seems to have a very unfortunate tendency to give out at unexpected times—a contingency which must always be provided for.

Artificial Gas.—There has lately been considerable discussion of the advisability of substituting artificial gas for coal in large stations. One advantage claimed for such a substitution would be that the gas could be produced from the coal at a point convenient to rail and water, and then delivered through pipes to a central station located near the center of distribution of the system. The idea is, of course, that electrical energy can be produced cheaper in this way than by systems which require either the carrying of coal across land from the railroad to the power station on the one hand or on the other of transmitting the energy generated at the railroad to the center of distribution by means of expensive feeders. Many central stations in Europe consist of gas-producing plants in juxtaposition with a gas-engine station; and it is claimed by the advocates of this method that a horse power hour can be produced on about one pound of coal.

Wood, Charcoal, Sawdust, Tanbark and Bagasse (the refuse from sugar cane) are all burned for fuel in certain localities peculiarly situated, where the circumstances generally leave but little doubt as to the advisability of their use. The heating value per pound for most woods is usually estimated at 4, the value of the same weight of coal.

Coal.—The true coals may be roughly divided into three classes, lignites, bituminous coals and anthracites, depending upon the percentage of volatile matter.

The lignites contain from 50 per cent. to 70 per cent. of fixed carbon, but can be but little used as fuel. The disadvantages of lignite coal are its extreme brittleness, its liability to spontaneous combustion on account of its oxygen-absorbing properties, and its large percentage of moisture, resulting in a low calorific power.

Bituminous coals may be divided into two principal divisions—caking coals and non-caking coals. The caking coals tend to fuse into solid masses and require constant attention during firing, while the non-caking coals burn readily and easily without stirring. The great advantage of bituminous coals is their low cost. Their disadvantages are that they clinker easily on the grate-bars, requiring constant and close attention while burning, and the handling of the large amount of ash produced requires additional labor. The percentage of ash may be so large as to cause the cost of the combustible part proper of the fuel to be as great as in a more expensive fuel. With properly designed boilers and furnaces handled in an intelligent manner it has been demonstrated in some cases that results may be obtained with low-grade fuels which compare very favorably with those obtained from higher grades.

Anthracite coals contain a large percentage of carbon, a very small percentage of volatile constituents and very little ash. Anthracite coals are very high in calorific power and burn with a clean fire which requires a minimum amount of attention and produces but little smoke. They can be handled very readily by means of conveyors and stokers, and their use enables the boiler-room to be kept much cleaner than is possible where bituminous coals are used. The disadvantages of using anthracite coals are their high cost when compared to that of bituminous coals and the fact that, in the western states especially, it is necessary to transport them over considerable distances, which makes the supply one easily affected by railroad blockades and strikes.

Heating Value of Fuels.—The best and most economical fuel is the one which will result in the greatest output for each dollar invested in the steam generating plant. The standard of comparison between two fuels will be the cost in each case of evaporating one pound of water from and at 212 degrees Fahrenheit, taking into consideration the interest on the required investment in the steam generating plants, a fair allowance for the depreciation of the same, the cost of the necessary labor to handle the fuel from the coal pile to the furnace and the original cost of the fuel delivered at the station. Very often the location of the station determines the kind of fuel to be used. In some cities the use of soft coals is not allowed on account of smoke-prohibiting ordinances, in which case it is imperative to use hard coal; but very frequently it is quite a question which one of a number of available fuels will be the most economical to adopt. There are three ways to compare the relative heating values of fuels:

First—By having a chemical analysis made. The chemical constituents of coal which contribute to its heating value are carbon and hydrogen, and the heating power in British thermal units may be calculated from Dulong's formula as follows:

$$\text{B. T. U.} = 14500\,C + 62500\left(H - \frac{O}{8}\right)$$

Where C = parts of carbon in 100.
" O = " oxygen "
" H = " hydrogen "

It will be seen by inspection of this formula that the oxygen in the fuel is supposed to unite with sufficient hydrogen to form water, which is driven off in the form of moisture, consuming a number of heat units which reduces the available heat proportionately. The remaining percentage of hydrogen is multiplied by its cor-

responding heat of combustion, and the result is added to the amount of heat obtained from the combustion of the carbon. This gives the total number of heat units theoretically present in the fuel. The chemical analysis giving the percentage of carbon, oxygen and hydrogen in the fuel is known as the ultimate analysis. The proximate analysis, which gives the fixed carbon, volatile matter, moisture and ash, may be taken, and from it the heating value can be determined. Of the two methods, the results obtained from the proximate analysis are the more reliable.

Second—The second method of determining the heating value of a fuel is by a calorimeter test. A calorimeter is an instrument in which a known amount of fuel is burned under such conditions that its heat is absorbed by a known quantity of water. By determining the rise in temperature of the water the number of heat units given off by the combustion of the fuel per unit weight is ascertained. With a modern calorimeter the results obtained may be very accurate and reliable. This second method is regarded by good engineers as a very satisfactory method of comparing the calorific value of different grades of fuels. The use of the first and second methods requires the knowledge of an expert. Tables are easily obtainable, however, giving the results of numerous tests and analyses of American fuels which, will be found useful for purposes of comparison. The most practical way of determining the relative heating properties, however, is the third method.

Third—The third method is an actual test in a steam boiler. This, of course, is the way that will naturally appeal to the man who pays the bills, and is the only method that, beside comparing the actual heating value of the fuels, at the same time furnishes a basis for comparison of the other items affecting fuel economy—such as cost of labor in handling the fuel, attending to the fire, removal of the ash, etc. Considerable good judgment must be exercised, however, in comparing fuels in actual boiler tests. The object, of course, is in each case to determine the highest practical heating value of the coal in an evaporative test, and the results will be reliable only when the conditions of the grates, the furnace, the amount of heating surface and the method of firing are the best for each particular sample of fuel tested.

No general laws can be laid down arbitrarily for the selection of a proper fuel for a power station. The proper selection, however, is a question of vital importance, and one which cannot fail to affect the dividend-earning power of the station. If enough has been said to show the importance of an investigation into the conditions of the local supply of fuel in each particular case, this discussion has not failed in its purpose.

Appliances for Economy.—With a fair understanding of where the heat units come from and where they go in a plant, we are now in a position to examine in detail the different appliances which go to make up the equipment of a power station, with the object in view of acquiring information which will enable us to make the most economical selection and arrangement in each particular case.

It is well known that the cost of electric energy as produced in the average central station is very high as compared to the cost of the output of other classes of power. From data collected by a committee of the National Electric Light association, it appears that in a great many electric power stations the consumption of coal per horse power hour averages over 12 pounds, while the same report mentions a pumping station developing a horse power hour on a consumption of 1.34 pounds of coal. A great part of this difference can, of course, be charged to poor management and improper handling of the machinery, but in many cases the poor economy can be traced directly to the unintelligent arrangement of the plant and the poor judgment used in the selection of its parts. It is now proposed to show the essential and desirable qualities which should be possessed by each separate part of a power station—how the choice of each part may depend upon the selection of other parts, and finally the arrangements as a whole which are adapted to best economy of operation. The predominating idea throughout is to secure the highest economy. The discussion naturally begins with the

Selection of the Furnace and Boiler.—It has already been shown that in average boiler practice hardly 70 per cent. of the heat units contained in the fuel delivered through the furnace door is transferred to the steam which passes out of the boiler ready for use. In a boiler plant poorly designed this loss may run far over 50 per cent. By careful engineering it may, however, be reduced, and it will not be at all unreasonable to expect an efficiency of 75 per cent., though it would be a very fortunate set of circumstances which would give as a result any better. To abstract the greatest number of heat units from the fuel, the following conditions are necessary:

Complete Combustion.—If the carbon in the fuel is completely burned it combines with oxygen to form carbonic oxide (one atom of carbon with two of oxygen) CO_2, producing a "heat of combustion" of 14,500 British thermal heat units. If, however, there is imperfect combustion of the carbon the product is carbonic acid, CO, only one atom of oxygen combining with each atom of carbon, and the resulting "heat of combustion" is only 4,400 British thermal units—less than one-third the possible amount. The importance, then, of burning the coal under such conditions that a sufficient supply of oxygen is always available is easily seen. Each pound of carbon requires $2\frac{2}{3}$ pounds of oxygen to burn it to CO_2. Air contains 23 per cent. of oxygen by weight; therefore $2\frac{2}{3}$ divided by .23, or 11.6 pounds of

[*Continued on page 206.*]

Turbine Installations.

Where water power can be utilized the producer of electricity is freed from anxiety as to the price of coal or miners' strikes. Coal blockades, the machinations of the Standard Oil company or the prospect of a failure of the supply of natural gas have no terrors for him who relies on the power of an unfailing water-course. The problem of selecting a water wheel is, however, of great importance to the electrical man so situated, who is naturally anxious to obtain all the information he can on the subject. The McCormick turbine, made by the S. Morgan Smith company of York, Pa., with two interesting examples in practice, is selected for brief description.

The McCormick wheel (Fig. 1) is the invention of John B. McCormick, who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery.

Fig. 2 represents a 400 kilowatt generator directly connected to a jack-shaft driven by two vertical 60 inch

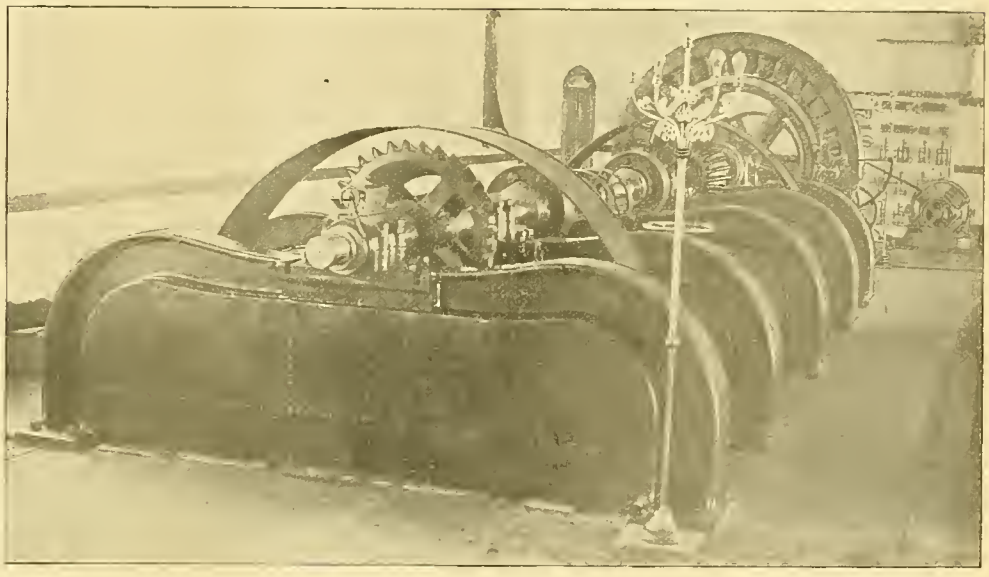


FIG. 2. TURBINE INSTALLATIONS.

McCormick turbines. These turbines, shafting and core gears (10 feet in diameter and 18 inches face) were furnished to the Montreal Cotton company, Valleyfield, Canada, and have been in operation some months. So well pleased were the owners that they placed their order for a second outfit, which has been shipped.

A larger plant is shown in Fig. 3, which represents two pairs of horizontal 42 inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water-wheel shaft, which extends into the mill, by three rope sheaves 10 feet in diameter, having 45 grooves for $1\frac{3}{4}$ inch ropes. There is also a 27 inch McCormick turbine on a horizontal shaft, direct-connected to a 1,000 gallon fire pump. This turbine also drives a dynamo. The combined power of these turbines is 2,355 horse power. The water is supplied to the turbines by two pipes 10 feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No. 3 mill of the Clifton Manufacturing company, Clifton, S. C.

The plant of the S. Morgan Smith company covers several acres of land and is equipped with fine new machinery, some of it of very large size. Some of the boring mills and pit lathes are large enough to allow of pulleys, rope sheaves and fly-wheels being turned off and bored out as large as 25 feet in diameter and six feet wide upon their face. There are also some large machine tools for cutting and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face. The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. They have spent much money on the improvement of the McCormick turbine, which they recommend for careful investigation.

Proposed Organization of Electrical Men in St. Paul and Minneapolis.

The Electro-technic club, an organization of electrical engineers of Minneapolis, gave its last dinner on April 1st. Prof. George D. Shepardson, of the Department of Electrical Engineering at the University of Minnesota, presided, and several interesting addresses were made. The meeting was announced as the last of the society, which has been in existence for something over a year, and which is now to be reorganized as the Twin City Electrical Engineers' club. A committee on organization was appointed, and A. W. Zahm, superintendent of the Manhattan Light, Heat & Power company of St. Paul, was instructed to induce the St. Paul electrical engineers to join the new club with a view to holding alternate meetings in the two cities. Charles L. Pillsbury, O. T. Erickson, Morgan Brooks, Albert W. Zahm, C. H. Chalmers and others made speeches.

The Telephone in the White House.

Mr. McKinley is the first of the presidents to use a telephone, according to William E. Curtis in the *Chicago Record*. Mr. Cleveland never touched one. Whenever he had a message to send it was communicated through Mr. Thurber or Mr. Montgomery, the telegraph and telephone operator at the White House. But President McKinley finds it a great convenience: it saves a great deal of time for his cabinet officers. When Mr. Cleveland wanted to ask a question of Secretary Olney or Secretary Morton or any other member of his cabinet he summoned him to the White House, which cost considerable time and trouble. Instead of doing this Maj. McKinley has the telephone operator call up Postmaster-General Gary or Secretary Bliss, and says:

"Hello! Is that you Gary? Don't make out the nomination for the Roaring Creek postoffice until I see you again. You can make out Gordon's commission, postmaster at Chicago, immediately, and I will sign it so that it can be delivered as soon as he files his bond. Am very well, thank you. How are your folks? Much obliged. Good-by."

And then he goes to the office-seekers again.

Prof. Dussaud's Microphonograph.

It is announced from the University of Geneva that Professor Dussaud has invented an apparatus to enable the deaf to hear. The microphonograph magnifies the human voice in the same way that a lens magnifies. It is simply a telephone connected electrically with a phonograph, but a far more sensitive phonograph than Edison's ordinary model. A battery of one cell to 60, according to the degree of deafness, is used. Of course, the apparatus is useless in the case of absolute deafness, but such an infirmity is far rarer than is suspected. The London correspondent of the New York *Sun*, who describes this invention, says that 95 per cent. of so-called stone-deaf persons can be made to hear and understand by Dussaud's invention. Prof. Dussaud is preparing for the 1900 exhibition an apparatus which will enable 10,000 people who may all be deaf in the common acceptance of the term to follow a lecture.

There is talk at Rochester, Minn., of moving the electric light station to larger quarters. The total cost would be about $10,000.

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WITH the first indication of the revival of trade the electrical workers of Chicago determine to indulge in a strike. Electrical construction work was stopped on six large buildings in this city last week, it is said, because the contractors failed to comply with some new regulation of the trade organization which went into effect at that time.

AS A convention city Niagara Falls promises to outdo itself this year. A temporary structure is being erected for the electric light and street railway men who will assemble there in June and in October, and every facility will be provided exhibitors who may wish to display their apparatus.

The street railway meeting will have in addition to the operating and construction men, a large representation of accountants who will hold an auxiliary convention at same time. This is the first practical step that has been taken toward securing uniformity in the methods of keeping street railway accounts. It will be the object of the meeting to adopt a system by which the reports of different roads may be compared. At the present time these statistics are valueless because there is no means of telling how the several items are computed. With a uniform system of accounts it would be easy to compare the cost of operating expenses in different cities, and the information thus gained would be valuable to the corporations.

OBJECTION is made by central station managers that where city lighting plants are maintained the public is not given a detailed statement of the expenditures of the department, and is therefore unable to make a correct estimate of the actual cost of the service. The second annual report of the light and water trustees of Oxford, Ohio, is absolutely valueless, because it is so elaborately indefinite. The city might discontinue the publication of all such reports with advantage, thereby effecting a slight saving without in any way depriving the taxpayers of valuable information. The trustees evidently do not propose to take the people into their confidence.

THE completion of the Union loop for the accommodation of the Chicago elevated roads in the down-town business district is announced this week, and it is added that the Metropolitan company will be ready to take advantage of it early in May. It is also stated that the work of construction on the Northwestern "L" road is being pushed ahead rapidly, and that plans for the electrical equipment of a section of this road will soon be completed. This will be one of the largest contracts in electric railroad equipment that has been undertaken in Chicago, and it promises to add considerably to the amount of electrical work to be done in this city during the present year.

NOW that the municipal elections in Chicago have been held, the legislators at Springfield will feel at liberty to take action upon the Humphrey bills. The fact that final consideration of these measures was postponed until after election is construed by the friends of the bills as a favorable indication. During the last few weeks the railway companies have secured many thousands of names to petitions in favor of the bills, and it is hoped that this showing will counteract the influence of the mass meeting at Battery D which denounced the measures and threatened vengeance upon everyone who supported them. With a few modifications the bills would enlist the support of many tax-payers who are now violently opposed to them, and it is believed that these changes will be made before the measures are finally enacted.

FENDERS are generally considered necessary for the safe operation of electric or cable cars in city streets, but as a rule the claim of street railway men that an efficient and reliable type has not yet been devised is accepted. A test case has been considered before the Supreme Court of New Jersey which has decided that municipal authorities having the regulation of the use of streets have the power to pass all ordinances, to reasonably guard and secure ordinary public safety and convenience, whether in relation to the construction of an electric street railroad or its equipment. Upon reason and authority, it especially insists, in the case of Cape May, Delaware Bay & Sewell's Point Railroad company against the city of Cape May, that an ordinance is justified, as an exercise of reasonable municipal or police power in behalf of the protection of the public engaged in ordinary business or travel upon the streets of the city, which requires that all passenger cars operated by electric power in the streets of the city shall have proper and suitable fenders on the front of such cars to prevent accident, and makes it unlawful to operate such cars in the streets of the city without such fenders.

THERE was a time within the memory of man when train wrecking was as popular in the West as the more genteel occupation of railroad wrecking now is in Wall street. But time has worked wondrous changes. In the West the more dangerous diversion has given way to the practice of the gentler arts of peace, while in the East for some unaccountable reason there seems to have suddenly developed a disposition to indulge in the hazardous practices of the banditti. Trolley cars operated upon suburban roads seem to be the special object of aversion. An attempt was made last week to wreck one of them upon the line of the North Hudson County Railway company, near Edgewater, N. J. The road runs from the Forty-second street ferry, Weehawken, along the Palisades to Coytesville, above Fort Lee. On the return from Coytesville the car was running at a high rate of speed, and when near the Edgewater station the motorman saw a mass of stones and several logs piled upon the rails a short distance ahead. He reversed the motor and stopped the car a few feet from the obstruction. Incidents of this kind lend novelty to the life of our eastern friends, who have become so thoroughly imbued with sensational ideas that they require something startling to interest them.

THE utilization of the electric current for cooking and other domestic service has become quite common, and in some cases where the superior advantages of the system have been demonstrated it is looked upon as a necessity. Another field of application that has been developed to a considerable extent is in the heating of street cars that are operated by electricity. Aside from this there has been very little application of electric heating commercially. An example of what can be done in this line, however, is given in the leading article in this issue, in which Mr. Dunlap describes the system of heating the great power house at Niagara Falls. It is true that all the conditions favorable to the economical production of the current are to be found in this case, but there is no question that the problem of heating such a building is far more difficult than would be that of an ordinary commercial or residential structure. There are many advantages in this method that it would be well for architects and owners of large office buildings and fine residences to consider. It might be well for central station men to give the problem a little more attention. While it is not to be expected that electric heating is at once to be adopted generally, it is undoubtedly true that there are many cases in which it could be used to advantage.

INDIVIDUAL duty and responsibility where several companies use the same poles in electrical construction work was the subject of a interesting legal controversy which was recently decided in Newark. A telegraph company, a telephone company, a railroad company and an electric light and power company used in common a certain telegraph pole owned by the first named company. An employe of the railroad company was engaged in helping remove its wires to other poles, and had ascended the pole in question; his left foot was thrown over one of the crossbars, "dangling down," so that when he reached out for a telephone wire that was handed him it is supposed that the foot touched an imperfectly insulated wire of the electric light company and the lineman was subjected to a shock which killed him. The administrator of his estate sued the Newark Electric Light & Power company for damages, and the United States Circuit Court of Appeals has affirmed a judgment for the plaintiff. In the opinion accompanying the decision the court says that the only rule which the lineman and the electric company, respectively, were bound to obey, was the general one which enjoins the exercise of due care—the observance of such caution as, under the circumstances, an ordinarily prudent man would have given. There is no liability for negligence where there is no duty of care. In such a case as this one, its special facts are for consideration, and upon them, and not solely with reference to the ownership or occupancy of the place where the accident occured, the question of duty must be determined. The duty of care, which the law imposes upon those who undertake to operate so dangerous a force as electricity, may even, under some circumstances, be due to one who technically is a trespasser. Furthermore, the court says that the several occupants of this pole had by virtue of the contract under which they jointly used it, a common interest that its use should not be environed with unnecessary danger. And it holds that each of them owed the duty to take all reasonable precautions for the prevention of injury to the servants of any of the others, who might be sent there in pursuance of the common right. Nor was this duty so circumscribed that it ceased to exist if any one of these servants happened to rest his hand, or place his feet, upon a cross-bar. It was bound to know that they might come in contact with its wires. Consequently, it was demanded that while this lineman was working, as others in the business would work, his life should not have been put in jeopardy by an unknown and invisible peril, to which he might unconsciously or involuntarily be drawn, and from which, by taking ordinary care, the electric company might have protected him, such as an imperfectly insulated wire.

His Days Are Numbered.

Public opinion demands the dismissal of John P. Barrett from the city service. The *Chicago Record's* disclosures of the last few months have convinced the taxpayers of Chicago, as well as the electrical fraternity and the insurance interests, who were already familiar with the character of the city electrician, that a change in that office is imperatively demanded. Barrett finds himself confronted with a desperate condition of affairs. The electrical fraternity is united in its opposition to him. Those who have been denied an opportunity to bid for city work recognize in the present movement the opportunity to rid themselves of this man, and, strange as it may appear, those who have benefited by his discriminations have turned against him. Even those who formerly sustained the closest relations with him find Barrett too great a burden.

The action of the insurance men is familiar to readers of this journal. They have determined to act independently of the city electrical department as long as Barrett controls it, and they have notified electrical contractors to that effect.

Probably the most significant action, as indicating the point to which public opinion has advanced in connection with this movement, is the actual appearance of candidates for Barrett's position.

These incidents have had their effect upon the practical politicians around the city hall, and they are showing their displeasure. They appear to be of the opinion that Barrett has become indiscreet; that he can no longer be depended on to exercise good judgment; that his brutal methods, which comprise vicious attacks upon all who dare to offer legitimate opposition to his methods, are raising up against him a legion of enemies in all quarters. Briefly, they consider that he has become an unsafe man, and is no longer to be trusted even for their purposes.

Deserted by his former confederates, opposed by the electrical and insurance interests, and now objected to by the taxpayers, Barrett is in a position which must shortly prove untenable. Nor can he hope for relief from the incoming administration, as candidates for mayor prior to the election pledged themselves to clean out every department which, like Barrett's, has favored certain contractors and discriminated against others.

The latest chapter in the scandalous proceedings that marked the awarding of a contract for fire-alarm boxes to Barrett's company was published in the *Chicago Record* of April 1st and is here reproduced:

There is a puzzle in dates on the books of the fire department. It is in the city telegraph account, which Prof. J. P. Barrett audits, and Fire Marshal Swenie formally approves after him. Marshal Swenie offered an explanation of the tangle yesterday. After he had finished the fact still remained that a bill of the Police Telephone & Signal company for $10,025 was approved and a voucher for the amount made out before the contract for the goods was signed or the goods delivered.

The bill and the voucher relate to the last purchase by the city telegraph department of 75 fire-alarm boxes and 25 police-alarm boxes from the Police Telephone & Signal company, western agent for the Gamewell company of New York. The prices paid were $100 each for the fire-alarm boxes and $75 each for the police-alarm boxes. This is the contract which Mayor Swift had reopened to allow the United States Fire & Police Telegraph company an opportunity to offer a fire-alarm box for $45, which the *Record's* expert commission decided was as efficient as the $100 box of the Gamewell people.

The first bids for the boxes were opened December 30, 1896. The Police Telephone & Signal company was the only bidder. Upon the interposition of Mayor Swift bids were readvertised for and opened January 16, 1897. The United States company's figures on the fire boxes were $4,125 less than those of the Gamewell agents. Prof. Barrett tested the boxes and rejected the United States boxes January 28th. February 1st Mayor Swift and Comptroller Wetherell signed the contract.

The voucher for $10,025, however, bears the date of December 31, 1896, and is entered on the books of the city comptroller under that date. The stamp of the fire marshal on the company's bill is of the same date, and reads as follows:

APPROVED
December 31, 1896.
D. J. SWENIE,
Fire Marshal.

It is the date of the bill of the Police Telephone & Sigoal company that complicates the situation still further. This is "January 29, 1897." This is the day after Prof. Barrett recommended the purchase, and two days before the contract was signed. It purports to have accompanied the delivery of "75 Chicago style fire-alarm boxes—$100—$7,500, and 25 police telegraph signal boxes—$75—$1,875," as well as two joker outfits, although the boxes are of a special pattern, and the manufactory of the company is in New York city.

The boxes were not delivered until the end of February. The initials "J. P. B.," Prof. Barrett's regular "O. K.," appear on the bill.

The voucher, which is No. 54,948, of 1896, gives the items of the bill, which are indorsed "Correct, D. J. Swenie, Fire Marshal." It was paid March 13th, the receipt being given by E. B. Chandler, treasurer of the Police Telephone & Signal company. The word "December" is stamped in red ink on the voucher. The entry on the comptroller's book, against fund "F" of the fire department, which is for the maintenance of the city telegraph service, is near the end of the items which come under the head of "December 21st."

Marshal Swenie claims the bill of the company was not approved by him on December 31, 1896, but was so stamped to bring it into the department appropriation account for 1896. He makes the same explanation concerning the date of the voucher.

The account with the comptroller for 1896 did not close until February 1st, this year, and vouchers for purchases against the 1896 appropriation were received and entered until that date.

The marshal says the bill was sent in and approved by him before the contract was signed or the goods delivered. It is his recollection that the voucher was sent up to the comptroller's office during the last days of January, and this is supported by the recollection of the bookkeepers in the comptroller's office, although there is no record of the date of receipt. The marshal claims he sent with it orders to have it withheld from payment until notice was sent that the goods were received and accepted. The voucher, however, bears all the marks of formal approval, and only by irregular proceedings could it have been withheld from payment if the company had demanded the money.

"I had the voucher and bill dated back to bring them under the appropriation of 1896," said Marshal Swenie yesterday. "I do that frequently to get as much out of the old year's appropriation as possible. Otherwise it would have to come out of this year's appropriation. The money was not paid until the goods were delivered, and I gave orders to that effect. They held the voucher in the comptroller's office until I released it."

Further disclosures of the *Record's* investigation were presented on April 5th, when the subject of the prices paid for lamp-posts was considered. Here is the *Record's* report of the result of its investigation:

Prof. J. P. Barrett buys the electric-light street lamp-posts for the city. This is part of his duty as head of the city electric-light plant. As there are many corners in the city to be lighted, the number of lamp-posts is large.

The price Prof. Barrett pays for them is also large.

Of styles and sizes the posts present a great variety. Some are tall and some are short. They have double-arm "hoods," which throw a double shadow on the street; single-arm "hoods" of later pattern, which throw no shadow on the street, and only a dark line on the building behind. There are boulevard posts of more artistic design, and alley posts with a long "goose neck" to hold the lamp over the alley and throw the light a greater distance in either direction.

But for all these various shapes Prof. Barrett pays the uniform price of $50 for each lamp-post. He buys them all from the Western Electric company, and uses a type known as the "Western Electric Columbian."

Although there are a dozen or more prominent firms in the city which manufacture or furnish lamp-posts, they get no business from the city electric-light plant. Prof. Barrett generally orders the "Columbian" posts from the Western Electric company as he wants them. The contract for lighting Ogden avenue, on which bids were received recently, seemed to invite competition in the matter of furnishing posts and other material, but the specifications called for Western Electric posts. Prof. Barrett says he does this to secure uniformity of style throughout the city.

The uniformity of his price is costing the city nearly double what any other public institution here has paid for lamp-posts. A comparison of city prices with those paid for lamp-posts by the World's Fair in 1892 and the West Park board in 1896 shows that during 1896 the extra cost to the city on Prof. Barrett's purchases amounted to $2,081.55, and that since the construction of the city plant in 1888 the extra cost has been $20,163.20.

The electric light plant of the World's Fair was put in in 1892, and E. R. Graham of D. H. Burnham & Co., who was assistant director of works, secured the posts for $24 each. They are much more ornate in design than the posts used by the city, and of the same size, which were then costing $50 each. At present the South Park commissioners are selling the surplus stock which has not been used since the close of the fair at $15 each.

The West Park board recently had installed with the rest of its electric plant about 1,000 lamp-posts, in the parks and along the boulevards. They are of two designs, and are considered the most artistic and costly lamp-posts in the West. The ones used on the boulevards have the "goose neck" of graceful design which carries the lamp over the roadway. These are the most expensive of the two classes. They cost $26.16 each. They were furnished in sections and the expense of assembling and painting brought the total price for each to $28.46.

The other class, which are straight, have a "hood" or "harp" for supporting the lamp, and are similar to those used by the city, but of more elaborate design and finish, costing $24.66 each, or $26.96 painted and assembled. These posts were specially designed by Forée Bain, the special engineer for the West Park board, who designed and supervised the construction of the entire plant. He first examined the style of post used by the city, and made a design which he considered an improvement on the Western Electric post for practical as well as ornamental purposes.

The bids on the straight posts, on which the awards of contracts were made, were as follows:

Union Foundry Works, upper and lower sections	$20.25
Michigan Pipe company, wood (middle) section	2.16
Hart & Hegeman, switches	2.25
Total cost per post	$24.66

It costs $1.25 to assemble and $1.05 to paint each post. As the park posts have no "bonnets"—sheet-iron coverings for the lamps—a cost of $2 for this item may be added to these figures for purposes of comparison. This would bring the cost of each park lamp to $28.96. The cost of the World's Fair and West Park lamps will then average under $27, as delivered in the condition in which the city receives its posts.

In the following table the vouchers paid to the Western Electric company during 1896 are listed, with an estimated cost figured on the competitive basis adopted by the World's Fair department of works and the West Park board:

	Cost to city.	Estimated cost on competitive basis.
Jan. 30, 9 Columbian lamp-posts (without switches), $47.50	$ 427.50	$ 222.75
July 3, boulevard lamp-posts, $50	150.00	81.00
July 7, boulevard lamp-posts, $50	350.00	189.00
July 8, boulevard lamp-posts, $50	150.00	81.00
Sept. 1, 9 Columbian lamp-posts (complete) $50	450.00	243.00
Sept. 17, 8 Columbian lamp-posts (complete), $50	400.00	216.00
Sept. 18, 2 Columbian lamp hoods $25	50.00	27.00
Sept. 21, 2 Columbian lamp-posts, $50	100.00	54.00
Sept. 21, 6 Columbian lamp-posts, $50	300.00	162.00
Sept 26, 5 Columbian lamp-posts, $50	250.00	135.00
Sept. 30, 5 Columbian alley lamp-posts, $50	250.00	135.00
Oct. 14, 8 Columbian lamp-posts, $50	400.00	216.00
Oct. 15, 4 Columbian lamp-posts, $50	200.00	108.00
Oct. 16, 9 Columbian lamp-posts, $50	450.00	243.00
Oct. 30, 4 Columbian lamp-posts, $50	200.00	108.00
Nov. 2, 1 Columbian blvd. lamp-post, $50	50.00	27.00
Nov. 4, 4 double-arm Western Electric hoods, $20	80.00	43.20
Dec. 29, 5 Columbian lamp-posts, $50	250.00	135.00
Totals	$4,507.50	$2,425.95
	2,425.95	
Extra cost	$2,081.55	

Every year Prof. Barrett sends to the city comptroller an inventory of the electric light plant. A table compiled from these inventories showing the purchases of lamp-posts, the cost to the city each year, and the extra cost figured on the World's Fair and West Park prices, is given below. During the first two years a number of small and inexpensive posts were bought, and on these no estimate is made, the city price being used in both columns.

Prof. Barrett says there has been practically no change in the prices paid by the city since the modern improved poles came into use. The relative value of the lower portion of the posts, sometimes called the "masts" and the "hood," is at present 60 and 40 per cent., and has not varied materially since 1889.

This table shows an extra cost to the city on lamp-posts amounting to $20,163.20. In the inventory for 1896 the cost to the city is estimated at $63,619 80, while the city price on posts alone amounts to $48,-821.78. This leaves an allowance of $14,798.02 for setting 1,131 poles, or an average cost of $13.

The West Park board paid $4.92 per pole, but the conditions met with in the city work are more complicated. Following is the table:

Year. Number lamp-posts added.	Cost to city.	Estimate cost on competitive basis.
1889. 252 posts	$ 3,327.78	$ 3,327.78
105 posts	210.00	210.00
322 posts, $28	9,016.00	5,216.40
296 hoods, $18	5,328.00	3,196.80
1890. 200 posts, $30	6,000.00	3,240.00
585 hoods, $20	11,700.00	6,318.00
1891. 82 posts, $30	2,460.00	1,328.40
113 hoods, $20	2,260.00	1,220.40
1892. 64 posts (complete), $50	3,200.00	1,728.00
1893. 16 posts (complete), $50	800.00	432.00
1894. No additions.		
1895. 2 posts (complete), $50	100.00	54.00
1896. 88 posts, $30	2,640.00	1,425.60
89 hoods, $20	1,780.00	961.20
Totals	$48,821.78	$28,658.58
	28,658.58	
Extra cost	$20,163.20	

Prof. Barrett, when asked to explain the cost of lamp-posts to the city, said.

"We use the Western Electric poles generally through the city. I do this for the sake of uniformity and because I consider the pole well adapted to the conditions as I find them. The Western Electric has a patent on its pole and I have to pay their price when I want it. It is a hard matter to get bottom prices on supplies I buy for the electric light plant. I get a few poles at a time and cannot get the benefit of these people who are letting contracts by 1,000 at a time.

"The Western Electric pole has been changed until I think it is admirably suited to the city. We are now advertising for some poles on Michigan avenue, where all the firms in the city will have an opportunity to bid. No; the price of poles has not varied much, and our poles have cost about $50 each as they stand. They are satisfactory to me and are doing the city good service."

Benjamin Butterworth, Commissioner of Patents.

The reappointment of Benjamin Butterworth as commissioner of patents has been well received throughout the country by the thousands of attorneys and others doing business with this important department of the government. Mr. Butterworth's previous experience in the office, his familiarity with the needs of the service, his intimate acquaintance with members of Congress and particularly with the members of the patent committees of the Senate and House, all give reason to hope that the new commissioner will be able to accomplish much for the Patent Office, especially in the direction of securing the passage of legislation that is generally recognized as necessary to remove existing defects in the system. Mr. Butterworth is known to favor the merit system, and is not likely to attempt many changes in the personnel of the Patent Office; but of course no one except himself can outline his policy in relation to the needs of the office force, as in the matter of increased room and facilities and improvements of like import.

Benjamin Butterworth, whose portrait is given herewith, was born of Quaker parentage about 60 years ago on a farm near Cincinnati. He was educated in that city, which was his home for many years, and there he studied law and was admitted to the bar. He served in the army during the war, and rose to the rank of captain. Returning to Cincinnati, he resumed the practice of law and soon achieved prominence in Republican politics, local and state, becoming finally a man of national reputation. Mr. Butterworth's services as an orator were in great demand, especially during political campaigns, and this has remained true throughout his whole career. Last fall he delivered a number of effective speeches, mostly in the Northwest, on behalf of McKinley and Hobart, and his efforts for the success of the Republican candidates were undoubtedly of much assistance to the successful candidates. Mr. Butterworth is particularly graceful and pleasing as a public speaker, and is unquestionably entitled to rank among the leading orators of the country.

The newly appointed commissioner has held many offices, elective and appointive, but is perhaps best known to the public at large by his service in Congress during the '80's. He served four terms as a representative from his native state and greatly added to his reputation by his readiness in debate and valuable service on committees. In his second term he was a member of the committee on appropriations, then considered the most important in the House, and he also served on the committee on patents, of which he became chairman. In 1883 Mr. Butterworth was one of the special counsel of the government appointed to prosecute the election cases in South Carolina. In October of the same year President Arthur appointed him commissioner of patents, and he served until March 3, 1885, when he resigned to re-enter Congress. About the close of his second period of service as a representative, Mr. Butterworth became a member of the patent law firm of Butterworth, Hall & Brown, organized in October, 1889. This firm had offices in Chicago and Washington, and the other members were Benton J. Hall, ex-commissioner of patents, who died early in 1894, and Frank T. Brown, formerly principal examiner in the electrical department of the Patent Office and attorney for the department under Mr. Butterworth, and now senior member of the firm of Brown & Darby of Chicago, the successor of Butterworth, Hall & Brown. In 1892 Mr. Butterworth retired from the firm and was appointed secretary and solicitor-general of the World's Columbian Exposition company. He was greatly interested in the World's Fair, and assisted in entertaining many of the distinguished visitors to Chicago in 1893. After the exposition Mr. Butterworth removed to Washington and resumed his law practice as the senior member of the firm of Butterworth & Dowell, with which he was connected at the time of his appointment as commissioner of patents last week by President McKinley, to succeed John S. Seymour.

Personally, Mr. Butterworth is very popular. He is a man of pleasing address, courteous and genial, and is universally liked. One who knows him well said a few days ago that he had "more personal magnetism than any other man in the United States." As a lawyer he is described as a close reasoner, with an intuitive faculty for seizing the strong points of a case and presenting them in a forcible and convincing manner. Mr. Butterworth has long been married, and he has three grown-up sons and one daughter.

Design and Construction of Electric Power Plants.

[*Continued from page 203.*]

air, are required to burn one pound of carbon. This is the theoretical amount for pure carbon, but with most coals no great mistake will be made by considering them as pure carbon. Practically, however, it is found that an amount of air considerably more than the theoretical amount must be supplied to the coal in order to effect complete combustion. With the ordinary chimney draught this amount of air is usually estimated at 24 pounds per pound of coal, about twice the theoretical quantity required. If too great a quantity of air is admitted to the fuel, the result will be an increase in the gaseous products of combustion which will necessarily be at a lower temperature. Thus the reduced temperature will affect the rate of conduction through the heating surface, and at the same time the increased bulk will make it more difficult for the heating surface to reduce the temperature of the gases.

If smoke is present in the gaseous products of the furnace, it is a sure indication of incomplete combustion. The presence of dense volumes of smoke pouring out of a chimney means just so much money lost, and represents a waste which is entirely useless. Smoke consumers are numerous, but the best way to prevent smoke and its consequent waste is not to produce it at all. For the best results the air should always be introduced through the grate. A hot, quick fire, bearing a bed of coals moderately thick, with a good, strong draft, is what is wanted. To attain this result it is of course as much a question of intelligent firing as a problem for correct design of the furnace proper.

The proper size and kind of furnace depends largely upon the kind of fuel to be burned. A good rule is to allow about 10 pounds of coal burned per square foot of grate area for anthracite coal and 15 pounds per square foot if the coal is bituminous. If the draft is very strong and the coal is free from ash, there will be obtained a

BENJAMIN BUTTERWORTH, COMMISSIONER OF PATENTS.

better rate of combustion per square foot of grate area than this, but it will be found a much simpler matter to reduce the size of the available grate area than to increase it, and the designer can afford to be liberal in this respect. The amount of air passage through the grate is made usually from 30 per cent. to 50 per cent. of the total grate area. If the fuel is liable to clinker, of course the air spaces should be larger than if the fire burns cleanly.

Rocking or Shaking Grates are useful, and if properly handled will contribute to the economy of the furnace, as they avoid the opening of the furnace doors to introduce tools which are necessary to keep the fires clean. Rocking grates get rid of the ash of the coal as quickly as formed, and in this way a poor quality of coal can be burned upon a less area of grate, and with less draft than otherwise.

The points to be considered in selecting a rocking grate are simplicity of construction, strength of parts, an action that will always furnish an abundant supply of air, easy manipulation and a thorough shaking movement. [Several well-known rocking grates were illustrated by means of lantern slides.]

Down-draft Furnaces.—The great disadvantage of the ordinary grate, fired in the usual way, is that every time the furnace door is opened a mass of cold air is introduced above the fire, cooling off the gases just at the time they should be the hottest. To avoid this disadvantage and at the same time allow hand firing—which, with a skillful fireman, is no doubt the best way to feed fuel to the furnace—there is often used a down-draft furnace. "In this type of furnace there are two separate grates, one above the other. The upper one is formed of a series of tubes opening at their ends into steel drums, or headers, which in turn are connected with the boiler, through which the boiler water continually and rapidly circulates. It is upon this upper grate only that the fresh fuel is fired, and the down-draft of air passing through the upper fire doors, which are constantly kept open, causes the gaseous matter from the green coal consumed on the upper water-tube grate to pass down through this mass of fuel. Whatever gases escape unconsumed are then burnt by the flames from the lower grate. The lower grate, formed of common bars, is entirely fed by the half-consumed fuel falling from the upper grate, and as the flame from this source ascends, it meets the downward burning fire from the upper grate and the joint draught current passes through the flues in the usual way."

Some additional heating surface is furnished by the water-tubes and connections. The advantages of such a furnace are that smoke is almost entirely prevented, that no cold air is introduced to cool down the gaseous products of combustion, that more perfect combustion of the fuel is obtained than with the average grate setting, that a greater consumption of coal per square foot of grate surface can be secured, and that the amount of ash is reduced because of the second grate. The disadvantages are that the furnace is not adapted to be automatically fed by coal-handling machinery, and that the labor account is usually higher than with ordinary furnaces on account of the fact that the firemen are constantly exposed to the intense heat of the upper grate.

These furnaces can be applied to any form of boiler and the results of numerous tests seem to indicate that with their use a slightly greater evaporation of water per pound of combustible can be obtained.

Mechanical Stokers.—This is another type of device intended to overcome the disadvantages attending the feeding of the furnace by opening a door above the fire as ordinarily required. With mechanical stokers the coal is fed automatically to the furnace. The device is usually driven by a small steam engine or an electric motor. The coal is delivered into hoppers either at the front of the boiler or in the side walls, from which it is uniformly fed forward upon a coking plate, where the volatile part of the fuel is driven off, leaving coke to be consumed in the furnace proper. This furnace usually consists of an inclined set of rocking grates, by the motion of which the coal is continuously moved down toward the bottom of the furnace, where the clinker breaker grinds all clinker and refuse into the ash-pit.

The use of mechanical stokers presents numerous advantages. The coal is fed uniformly into the cooler portions of the furnace and gradually worked to the hottest part of the fire, thus coking it before combustion takes place and partially preventing smoke. The cost of labor for firing and boiler attendance is reduced from 25 to 50 per cent. With the use of stokers the coal may be taken mechanically from the coal bins to the furnace without any manual labor whatever. The cheaper grades of fuel—bituminous, semi-bituminous and lignite coals—can be burned completely and handled successfully. The boiler is saved the wear and tear of contraction and expansion resulting from frequently being exposed to a cold blast of air from an open furnace door. With mechanical stokers the boiler room can be made as clean as the remainder of the plant, while the convenience of handling the fuel can only be compared to that resulting from the use of natural gas or oil.

Mechanical stokers, however, have some few disadvantages. The stokers cannot be "crowded" to any great extent, which results in the necessity of providing for a greater equipment of boilers than required when hand-fired furnaces are used. Furthermore, they are liable to get out of order, and their cost, which is necessarily greater than that of ordinary grates, will make their use unadvisable in a large number of cases, and especially in small plants, where no saving in labor can be effected on account of it being necessary to keep one man on duty at all times.

In purchasing mechanical stokers the following points should be carefully considered: First—Is the fuel adapted for stokers? Second—Avoid too much complication of parts. Third—Has the device been in service long enough to be considered successful?

Boiler Setting.—With most boilers it will be found best to erect and set the boiler according to the blue prints which will usually be furnished by the manufacturer of the particular type selected. It will always be found advisable to have the combustion chamber separated from the heating surface so as to avoid the cooling effect of the cold surfaces. With anthracite coals the heating surfaces can be placed much nearer the grate of the furnace than with bituminous coals. With anthracite this distance may be between 18 and 24 inches, while with bituminous coals it is customary to have from 24 to 30 inches between the grates and the heating surfaces, and it is sometimes found desirable to have the furnace four to five feet high. The furnace should be entirely lined with fire brick so as to keep the temperature as high as possible and prevent the cracking of the boiler walls.

The foregoing discussion on furnaces has properly come under the head of the first requirements of a good boiler, *i. e.*, complete combustion. Having transferred the greatest possible number of heat units from the coal to the gases, the second requirement will be to provide a means of passing the greatest number of the available heat units in the gases into the water of the boiler in order to form steam. This brings us to a discussion of the requirements of the boiler proper, and face to face with the question of the best type to be selected.

[The title of the third lecture in the series is "Boilers and Accessories."]

Advices from Caracas, Venezuela, announce that Jacob Schwed, agent for Henry Clews and other bankers in New York, has secured from the government a contract, by the terms of which the American financiers will control the telegraph lines of Venezuela for 30 years. The concession, which is of great value, will enable the syndicate to construct cable, telegraph and telephone systems in all parts of the country. Jacob Schwed went to South America three weeks ago as representative of a syndicate of capitalists.

Cazin Water and Steam Wheel.

The subject of the utilization of water power, which is becoming of so much importance, has received new additional matter in the shape of a pamphlet just distributed among civil, mechanical and electrical engineers generally throughout the United States, by the American Impulse Wheel company of New York.

The invention described in the publication referred to is a wheel of the free jet or percussion type (operated by either steam or water) which appears to go beyond anything of the sort hitherto known to the mechanical world in developing maximum efficiency of the motive power.

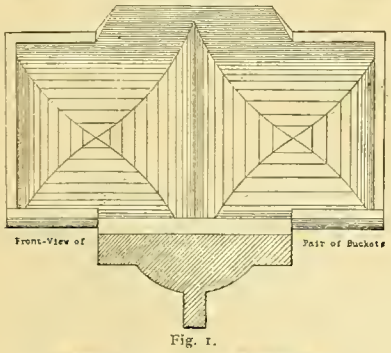
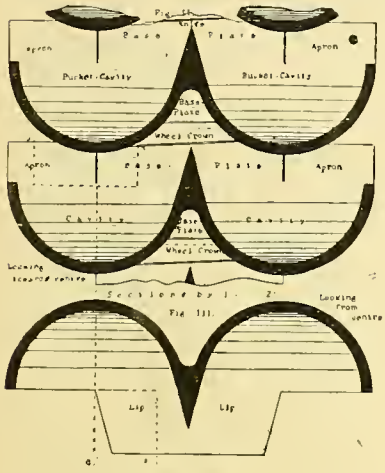


Fig. 1.



Figs. 2 and 3.

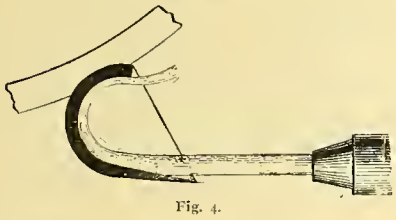


Fig. 4.

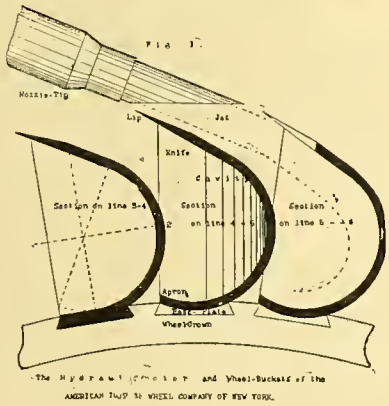


Fig. 5.

CAZIN WATER AND STEAM WHEEL.

It is taken as an established fact in hydraulics that the jet of water must be completely inverted by the vane or bucket of a wheel, traveling at half the velocity of the jet, in order to obtain the best results in transmitting the inherent power of the jet. It is unnecessary to quote authorities in support of this theorem, but it is of interest to note the claims of this new wheel company in complying therewith. The accompanying cuts more clearly than verbal explanations indicate the basis for the assertion that the wheel actually performs the work theoretically required.

Fig. 1 gives a front view of pair of buckets, in which the curves of the receiving lip and vanes are indicated by the shaded lines. Figs. 2, 3 and 4 show sections of the vanes, indicating not only the true curves, but also the course of the jet in contact therewith. Fig. 5 represents the positions of the vanes on the wheel crown and also the diagonal nozzle tip intended to provide against loss of power between the time the jet leaves the nozzle and contact with the buckets.

These cuts show the pertinent facts of the merits of the device, and it is claimed in the pamphlet referred to that the jet is not only inverted while the bucket is in its best position relative to the jet, but also completely and permanently in all positions taken by the bucket while receiving the jet impact—a necessary addition to highest efficiency hitherto overlooked by wheel manufacturers. In addition to these brief items, the book contains considerable information relating to power calculations, hydraulics, water rights and other matters. The invention is covered by patent rights issued to F. M. F. Cazin, inventor, and is offered for sale by the American Impulse Wheel company, 120-122 Liberty street, New York, which will furnish copies of the book upon application.

Automatic Circuit Breakers.

Fuse wire is often unsatisfactory as a protective device, and many engineers are turning their attention to the use of automatic magnetic circuit breakers as a reliable substitute for fuse wire. One type of these instruments is shown by the accompanying cuts, which represent the well-known automatic circuit breakers or limit switches made by the Automatic Circuit Breaker company, Newaygo, Mich., with the latest improvements. Fig. 1 shows the circuit breaker closed; Fig. 2, circuit breaker open, or as it appears after a circuit is broken; Fig. 3, a sectional view, on a line drawn through center of instrument. Referring to Fig. 3, *V* represents base, either marble, slate, or other suitable material, preferably slate; *A*, copper contact; *B* and B_1, carbons upon which they make their final break; *C*, dash-pot that gives break-frame its sudden blow through handle *T*, which has about one-eighth of an inch play, as shown at *L*, so that it gives break-frame a hammer blow, overcoming any possible chances for contacts *B* and *A* sticking; *D*, latch; *E*, small weight to return armature to place after instrument has operated; *F*, screw through armature holder, making contact on point shown at *G*, which is a piece of iron running to magnet core and is magnetized so that it holds armature up until current exceeds the predetermined point. The magnet *G* releases screw *F*, giving a hammer blow to *E* against latch *D* and released disk *F*, which is the catch on frame *R*, and a part of handle *T*, all movements being positive knock-out blows. *M* is the graduation plate, the graduations being in amperes. *N* is the adjusting screw for adjusting capacity, either increasing or decreasing to any predetermined point between the minimum or maximum graduations. All springs are displaced by a new and novel use of magnetism, which is always positive and never varying in principle or operation.

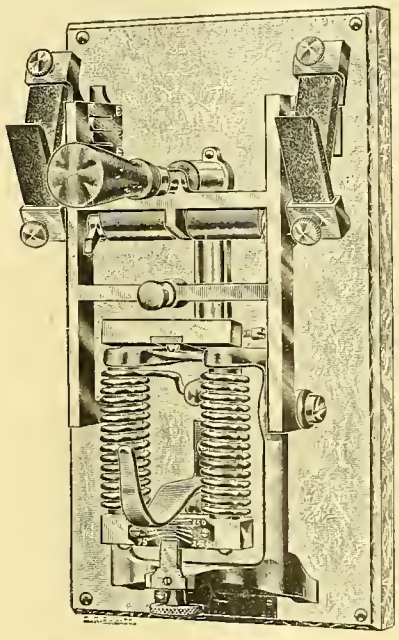


FIG. 1. AUTOMATIC CIRCUIT BREAKERS.

The company makes a positive guarantee that its instruments will operate within one per cent. of their set capacity under any and all circumstances. It has them for all systems and voltages, and claims to manufacture the only successful alternating current circuit breaker now on the market. It attributes a great share of its success to the fact that it sends out one or a full equipment to its customers subject to approval, and if the instruments are not entirely satisfactory customers are under no obligation except to promptly notify the company, so that it can send shipping directions for the return of the instruments.

This being the season of the year when one should look after the protection of his electrical apparatus from lightning, managers may well take up the matter of better protection to electrical apparatus by the use of automatic circuit breakers.

Not a Bucket Shop Victory.

[From the *Chicago Chronicle*.]

Under the head, "Bucket Shops Win," the press has published broadcast a statement that the recent decision in the Chicago Board of Trade and Western Union Telegraph company case was a victory for the bucket shops. The exact contrary is the fact.

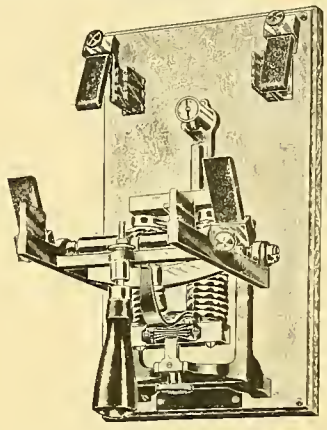


FIG. 2. AUTOMATIC CIRCUIT BREAKERS.

The case was that of an injunction against the telegraph company forbidding it to withhold Board of Trade market reports from two alleged regular commission firms. There was no allegation in the proceedings that the alleged commission firms were proprietors of "bucket shops." Judge Horton, in deciding the case, stated the general principles of law.

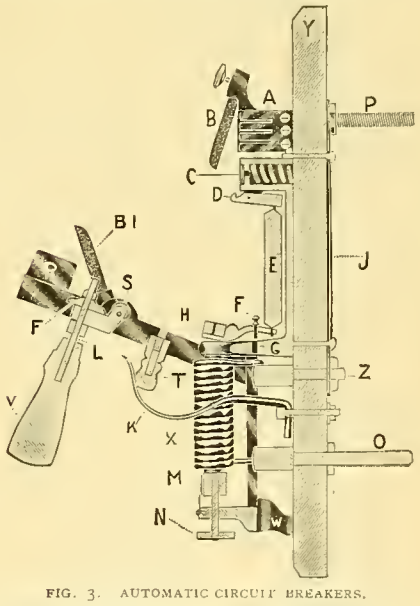


FIG. 3. AUTOMATIC CIRCUIT BREAKERS.

For 40 years the Board of Trade had given its reports of prices to the public through the telegraph, the press and other channels. By this long practice the market news "had become clothed with a public interest" and could not be withheld from the public.

This is as far as the decision went. The court said it did not follow that each and every member of the public had a right to go on the floor of the Board of Trade and pick up the news. The board had a right to establish proper rules and regulations for disseminating the reports of prices. But until some better way should be devised the telegraph lines should be regarded as a proper agency for the distribution of reports to the public.

But it was expressly said that the telegraph company had no right to deliver reports to bucket shops, which are run in violation of law. Holding that the reports are a "public interest," Judge Horton said that it was not an interest to which lawbreakers could lay claim.

Warren Electric Manufacturing Company.

A new manufacturing concern is always an object of interest, especially to those engaged in the same industry, but there are many special reasons for the attention that is being given the plans of the Warren Electric Manufacturing company of Sandusky, Ohio, by the electrical trade. As a matter of fact the company cannot rightly be classed as a new enterprise, although in a sense it may be so considered, inasmuch as it is now formed on a much more elaborate scale than was at first intended, and the scope of the field it will occupy is greatly enlarged. The reason for these changes may be found primarily in the cordial reception which was accorded the company's product from the start, which made it necessary to enlarge and improve the manufacturing facilities at once. Accordingly, arrangements were made for a transfer of headquarters from Chicago to Sandusky, O., and one of the most important electrical deals made since the arrival of panicky times was then effected by C. C. Warren, one of the veterans of the electrical business. It goes without the saying that everybody at all familiar with the growth of electrical development needs no introduction to him. A sketch of his career will be interesting at this time, and is appended to this article.

The deal referred to was the purchase of an extensive manufacturing plant in Sandusky, heretofore known as the Barney & Kilby Engine & Machine works, in the very center of the city and occupying over half of one entire city block only two squares from the postoffice. Transportation by five lines of railway connecting Sandusky with every trunk line of the United States, and with its magnificent Lake Erie harbor, affords unsurpassed shipping facilities to every section of the country.

The situation for an electrial manufactory seems an ideal one, as it is close to the very heart of the metal markets, where iron and coal meet and ore is transformed to finished product at the most natural point and to greatest advantage; midway between the wealth of the East and the developing West.

As will be seen by the view of the works, Fig. 1, and by reference to the ground plan and dimensions, Fig. 2, the plant is an extensive one.

The Warren machines have heretofore been built by contract, but the plan was not entirely satisfactory, and a search for suitable manufacturing facilities has resulted in the organization of a manufacturing company and the purchase, upon exceptionally favorable terms, of the Sandusky plant.

The Warren Electric Manufacturing company has a full paid capital of $200,000, a complete factory filled with suitable tools, the buildings substantial stone structures, a handsome cash working capital, not a dollar of floating debt and a most enviable reputation for the apparatus, which has been acquired in an unobstrusive but businesslike manner. The Warren alternator is in successful operation in Florida, New Jersey, Pennsylvania, New York, Ohio, Illinois, Indiana, Iowa, Minnesota, Colorado, Arizona, California and even Japan.

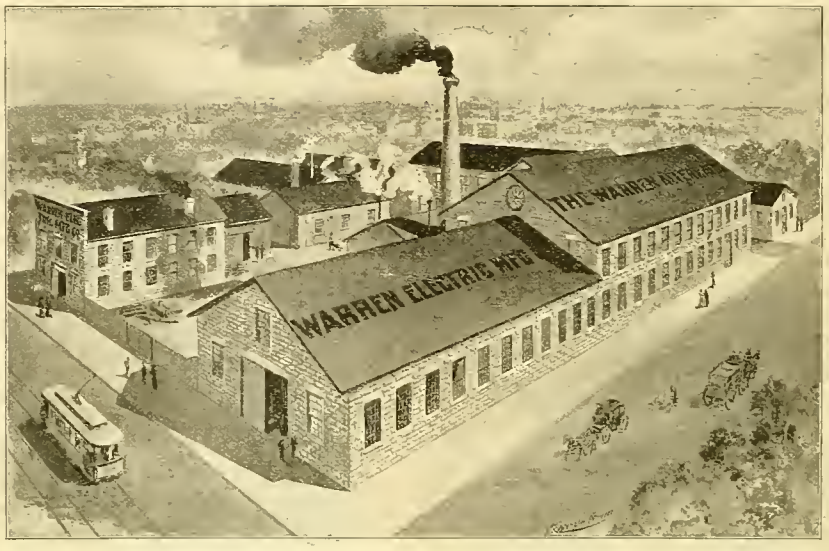


FIG. 1. WARREN ELECTRIC MANUFACTURING COMPANY.—VIEW OF WORKS AT SANDUSKY, OHIO.

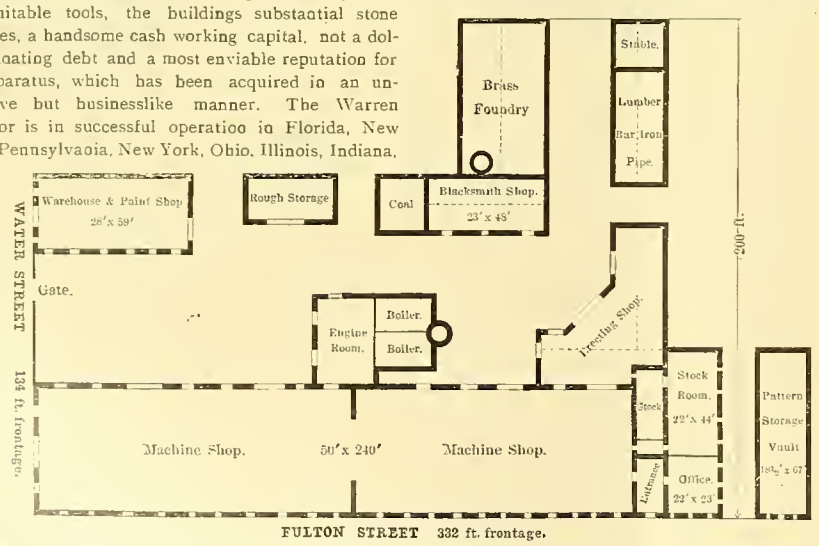


FIG. 2. WARREN ELECTRIC MANUFACTURING COMPANY.—PLAN OF WORKS, SANDUSKY, OHIO (GROUND AREA, 44,000 SQUARE FEET).

Its success now fully established, adequate manufacturing facilities secured, all without being handicapped by over-capitalization, inflation and unreasonable "fixed charge" account, and with the aggressive but conservative management of C. C. Warren, the company will doubtless do a large and prosperous business. The Sandusky company is the successor of the Warren Electric company of Chicago, the business having been done heretofore from Chicago by the latter named company. The officers of the company are: C. C. Warren, president; Jos. F. Kilby of Cleveland, vice-president; H. B. Warren, secretary; Charles F. Mack of Sandusky, treasurer.

C. C. Warren is one of the best known men in the electrical business, and he is one of the veterans who came through the panic unscathed His experience in commercial enterprises before entering the electrical field gave him considerable advantage over many of his contemporaries. In 1852 Mr. Warren, then at the age of 17, and having spent several winters in the old log and red-painted country school houses in Southern Michigan, secured employment in Cleveland, Ohio, in the old car works of Wasson & Co. He seemed to be a handy boy—engineer, woodworker, lathe tender, etc., but meantime was not fully contented with his lot. The bent of his inclination seemed to be toward commercial pursuits, and in 1854 he secured a position in a country store in Hillsdale, Mich., where he manipulated the sugar bins, nail kegs, mouse trap and fishhook departments, laces, kid gloves, drugs, silks, satins, hoopskirts, etc. His advance was rapid, and at the end of four years he was head clerk of the establishment, which was the most extensive of any for many miles around.

Having long since fallen in love, and being unable to wait longer for the girl of his choice, he married in 1858, and almost immediately thereafter his employers voluntarily proposed that he secure a location and start a mercantile concern of his own, for which they would provide the necessary capital. This token of recognition of the ambition and determination of their former employe was most gratefully received, and the firm of C. C. Warren & Co. of Three Rivers, Mich., was established, and for five years thereafter did a most prosperous and lucrative business, at which time the firm sold out, and Mr. Warren organized the First National Bank of Three Rivers, Mich., and he himself became its cashier. This bank has always been a very prosperous one, and is to-day one of the sound and reliable banks of Southern Michigan. Toward the close of the first year Mr. Warren found his health failing, which necessitated his resignation from the bank. In 1865, his health being restored, he established himself in Toledo, Ohio, in the wholesale coffee business, founding a business which he conducted for about seventeen years, the concern having long since established the second largest coffee business in the United States.

In 1881 a malicious and merciless six years' litigation terminated, in which Mr. Warren's firm were defendants, and while he was successful in every respect and won his cases, vindicating himself and associates, he discovered that his resources had become so greatly impaired by the costs and consequences of the litigation that he was compelled to reorganize the business with which he had spent the best days of his life. In the early part of 1882 the business was reorganized by the incorporation of a stock company, entitled the C. C. Warren Coffee company, under the laws of Ohio, in which all of the wholesale grocers of the city of Toledo had been induced to interest themselves, thereby securing the new company their co-operation, and eliminating their former active and pitiless competition. Upon the organization, election of officers, etc., some internal dissensions arose, and Mr. Warren became somewhat embittered, and after finding a man to take his place, which he did in the person of Mr. Woolson, he withdrew from the concern. The incorporated name was then changed to the Woolson Spice company, which has recently become famous the world over as the coffee concern which has sold out to the Sugar Trust, and which has recently put more than two millions of dollars into the pockets of the people who Mr. Warren only 15 years ago induced to engage in the business. In 1880 he organized the Citizens' Electric company in Toledo for the purpose of doing a general lighting business. This company was among the first electric lighting companies to be incorporated in the state of Ohio. When dropping out of the coffee business he naturally turned his attention toward the field of electricity, and in the middle of the year 1882 took up the management of the western department of the United States Electric Lighting company, locating the office in Chicago. The growth of the western business of that company under his management was simply phenomenal, as all the old-timers in the electrical business know.

In 1889 most people familiar with electrical matters will remember that the United States Electric Lighting company turned its business over to the Westinghouse company. Shortly thereafter Mr. Warren took up the management of the Central State district for the Edison company, remaining in charge until the early part of 1890, when he resigned for the purpose of organizing a railroad department of the Westinghouse company of Pittsburg. The arrangement was perfected, but soon thereafter the disaster which reached the Westinghouse company in 1890 could be concealed no longer, and he resigned from that company, intending to remain out of electrical business. The fascination, however, after so many years of life engaged in electrical pursuits, was too strong to keep him in retirement, and he began in 1893 to exploit the alternating current system, in connection with his son, H. B. Warren, and after spending many months of time and a great deal of money in the necessary experiments, the result is seen in the present Warren alternator, the demand for which has made it necessary to acquire adequate manufacturing facilities.

Mr. Warren is now in Sandusky at the head of his own company, with a manufacturing plant at his command, with every facility needed in the carrying out of his plans.

Associated in the present company is H. B. Warren, son of C. C. Warren, who has been mentioned as inventor of the Warren alternator, which was illustrated and described in the WESTERN ELECTRICIAN September 21, 1895. The young man graduated from the High School of Toledo, Ohio, in 1877, entered the counting room of his father, who was then conducting a large wholesale coffee business in Toledo. He was more inclined to dabble with the electrical matters than to confine himself to the humdrum of commercial pursuits, and his father's connection gave him an opportunity to do so. Electricity seemed to have a great charm for him, and in 1882, when C. C. Warren took the western management of the United States Electric Lighting company, his son took charge of a large department of the commercial work. Beginning almost with the installation of the then very important plant, the postoffice, St. Louis, Mo., the plant was completed in good time and promptly accepted by the government inspectors and was considered, at the time, a most remarkable installation. He then took charge of the construction business of the southwest, locating at Kansas City, where he installed many important plants. A year or two later the business of the Northwest grew in importance, necessitating

C. C. Warren.

H. B. Warren.

WARREN ELECTRIC MANUFACTURING COMPANY.

his removal to St. Paul to take charge of the construction department of the Northwest, where he continued until the United States company went out of business, at which time he engaged with the Thomson-Houston company as its electrical expert, remaining with it until the consolidation known as the Northwest General Electric company, with which he remained in a similar capacity until in 1893, when that company was wound up.

H. B. Warren received no technical schooling as an electrical engineer, for he was already up in the list of so-called "experts" long before electrical engineering courses were established in the technical schools and colleges. From the first, however, he had been a close student of electrical literature of a technical character, being mostly interested in lighting and transmission work, and the mechanical and electrical problems of dynamo performance. He kept in close touch with all advances and developments in these lines and was early fascinated with alternating current phenomena and possibilities. As a natural consequence of such sustained interest in the alternating current branch of the electrical business, he embraced the first opportunity to enter the field of machine construction, and in the fall of 1893 he went to Chicago and commenced working up the design of an alternating current generator which has already acquire famed as the Warren alternator.

The New York & North Shore Railroad company has made application to the Board of Highway Commissioners for a franchise for a trolley railroad through Flushing to Manhanset, Whitestone, Bayside and Jamacia, on Long Island. Sentiment toward the projected lines is thought to be favorable.

Portable Electric Lanterns.

The market demand for a reliable portable electric light, to supersede oil lamps and other usual modes of lighting, has been steadily on the increase. This is shown by the efforts of manufacturers to furnish electric light for bicycles, for private carriages and other vehicles as well as for (electric) hand lanterns for a variety of uses. The superiority of electric light for any use is unquestioned. It is clean, absolutely safe, brilliant, always ready and under perfect control.

The source of electric light for any of the above uses is in most cases some kind of battery. Primary batteries for such uses are obviously troublesome and in the end expensive. They require frequent attention and renewals, and are moreover not constant. Dry batteries, from the very nature of their construction, are not adapted to furnish a fairly uniform light for more than a few hours' continuous service, and, once discharged, they are useless. They have the advantage of being cheap, light, and of standing rough handling without injury, but these, except for a few special cases, do not offset the disadvantage of being obliged to get a new battery after a few hours' constant service.

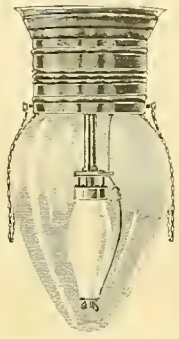
Storage batteries for portable lighting are the most reliable and satisfactory. The chief objections are initial cost, the necessary greater weight and the cost of recharging. The last named, with proper facilities, is not great; the necessary renewals and repairs are infrequent and trifling when compared with the same for either dry or primary batteries.

The accompanying illustrations show a few of the forms of electric hand-lanterns or portable electric lanterns in which storage batteries are the source of light. These outfits are designed and manufactured by the New York Accumulator & Electric company of 150 Nassau street, New York. The batteries are securely sealed (in hard rubber boxes) so as to prevent any spilling of the liquid, and are fitted in highly polished oak cabinets, provided with hinged covers that are faced with polished hard rubber. This special feature of a hinged cover admits of the cells being readily and quickly examined. In some forms (as shown in the accompanying cuts) the hinged cover contains the lamp and reflector, with the switch and necessary wiring. In other forms these are placed on the front side (as in a bull's-eye lantern), a lens being provided to concentrate the light in a particular direction. Connection with the terminals of the battery is securely made by means of insulated screw or plug contacts, so that no short-circuiting of the battery can occur. Each lantern is provided with a neat nickel-plated metal and leather strap handle for carrying and the name plate of the company. The lanterns are furnished in various sizes and capacities as desired.

For the lighting of private carriages, vehicles, etc., the lanterns are mounted in neat cabinets of any special desired size to suit the vehicle. Flexible insulated conducting cords connect the battery with the head lamps, bell, etc., each of which may be operated independently. In all these batteries special attention is paid to the protection of the positive plates so as to overcome the effect of jarring and the wash of the liquid.

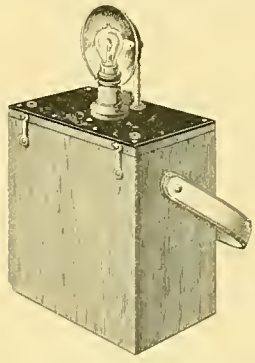
Upton Midget Enclosed Arc Lamp.

It has always been considered very desirable to make the arc lamp as short as possible, and this characteristic is especially desirable in the enclosed arc lamps, which are used so largely for interior lighting on incandescent circuits. The lamp herewith illustrated combines a



UPTON MIDGET ENCLOSED ARC LAMP.

handsome design with small size and great simplicity of construction. It is the Upton midget lamp, made by the Standard Thermometer & Electric company of Peabody, Mass. The mechanism of the lamp consists of a single solenoid which operates a lever connected with a clutch. At the end of the lever is a dry-air dash-pot. The upper carbon is held in a brass tube by a suitable holder provided with brushes bearing against the interior of the tube. The clutch embraces the carbon at

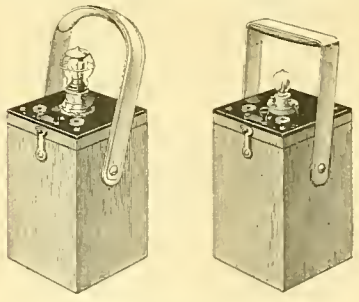


PORTABLE ELECTRIC LANTERNS.

its point of entrance into the enclosed chamber of opal glass surrounding the arc, and is insulated to prevent the formation of an arc between carbon and clutch. A single movement of the lower carbon-holder unlocks it from the enclosure globe and permits the trimming of the lamp. The resistance coil used for lamps on constant potential circuits is mounted in the upper case above the solenoid. The lamp, complete with the outer globe, is only 20 inches high, and without the globe 18½ inches. A special form for show windows is made with concave or convex reflectors replacing the outer globe, to replace the ordinary group of incandescent lamps mounted in a mirror reflector.

Electrical Mine Haulage at Kingston, Pa.

The Woodward mine of the Delaware, Lackawanna & Western Railroad company at Kingston, Pa., is about



PORTABLE ELECTRIC LANTERNS.

to be equipped with electric haulage by the General Electric company. The generating plant will consist of one 165 kilowatt dynamo directly connected to an American Ball engine. The circuits will be three in number. The first will pass down a vertical shaft 725 feet deep and will operate one 10 ton locomotive in the Cooper vein. The two others will be carried down another vertical shaft 1,026 feet deep to operate two 10 ton loco-

motives in the Red Ash and Baltimore veins. These locomotives will be equipped with two 40 horse power "G E" motors, and will handle trips of loaded mine cars, each loaded car weighing about 4½ tons. It is estimated that this installation will show in operation a net saving of 29 5 per cent. over mule haulage, including a large reserve for depreciation, interest and fixed charges. The total output of these three locomotives will be about 3,800 tons per day, and the total length of trolley wire in the gangway will shortly reach 4½ miles.

The Telephone Fight at Grand Rapids.

The following interesting and comprehensive summary of the telephone situation at Grand Rapids is from the *Michigan Tradesman* of March 24th:

The Bell Telephone company announced through the *Evening Press* last Saturday that it has set apart a million dollars for the purpose of crushing the competition of local companies in Michigan, and especially the Grand Rapids exchange, which has practically driven the Bell concern to the wall. In view of this attempted scare and bluff, the record made by the prophets and wise men in the employ of the Bell company proves exceedingly interesting at this time, especially when it is remembered that every prediction previously made by the Bell people has failed to materialize and that every bluff has turned out to be a very mild sort of zephyr. Note the different attitudes assumed by the Bell company:

1. When the franchise was granted to those interested in the independent telephone movement, the Bell company saw only a bluff to the end of securing reasonable rates and foretold that no subscribers could be secured for telephones or for stock and that it had absolutely no fear of the future.

2. Later, when 1,100 subscribers were secured for telephones and sufficient stock was subscribed to warrant organizing a company—in August, 1895—the Bell company proclaimed that the Citizens' company could never build a plant because first-class cables could not be purchased outside the Bell company; that proper telephone wire and competent workmen, superintendents and managers were not to be had, and that, even if these obstacles were overcome, no first-class instrument could be secured, as nothing better than the old Blake transmitter telephone was made, except the long-distance 'phone, upon which the Bell company held broad patents.

3. When the new company had its construction well under way, the Bell company claimed that it would never give service, because no switchboard could be bought which would give a decent service to 1,400 subscribers, because the Bell company owned all the patents; that a board necessary for 1,400 subscribers would cost over $30,000 to build; that the new company had expended all its capital and would never issue a directory nor complete its plant.

4. In April, 1896, the plant was so far along that the Bell company reduced its rates 50 per cent., still claiming that the new company could not give service and that, if it did, the income at the $30 business rate and $20 residence rate would not pay operating expenses.

5. July 1st the new company began a partial service which, although inferior at first, gradually improved, so that, before the end of the first quarter, it was giving very fair service, but a little slow, owing to new operators and a new board. Then it was that the Bell company proclaimed that it took two operators to make one connection on the new company's board and only one on its own (while, in fact, the new company had three operators on 200 numbers and the Bell had three operators on 150 numbers) and that the new company would soon fail, for the board was getting worse and in a short time the service would be so slow as to drive all patrons away.

6. Next the public was informed that the new company would fail because it would be forced, by suits, to abandon the use of apparatus upon which the Bell held patents and on which suits had been started. The public patiently waited, only to learn that as fast as the time of trial approached the suits were discontinued by the Bell company; and it is now stated that not a single suit has been begun on any patent that has been declared to be valid by any court, but on patents that the Bell company has never permitted to get before a court for a final hearing; that without question every suit is for the sole purpose of creating fear and doubt in the public mind and without any expectation of securing a decree.

7. Now, when it is generally conceded that the Citizens' company gives better service than the Bell; that its income does exceed it expenses; that, in spite of willfully false statements and deliberate misrepresention, it has succeeded, the old rumors of a "fine building," an "express system," a "million-dollar" expense, if necessary to kill off the new enterprise, are industriously circulated. In view of the fact that the new Detroit company is just beginning to give service to 5,000 subscribers and that nearly every important city in the state already has its independent exchange which is gradually absorbing the business and dissipating the income of the Bell company, so that its resources are no longer inexhaustible, it will be readily apparent that the Bell company is severely crippled, financially speaking, and that the latest announcement is simply a "scare," which will probably prove of no value to the Bell company and of no injury to its robust competitors, here or elsewhere.

Why should the Bell company expend a million dollars when the Citizens' company's entire plant to-date has cost less than $125,000?

The "million dollar" bluff recalls the statement made by the Bell company's agents when the Citizens' Telephone company announced that it would furnish telephone service for less than half the rates that had been hitherto charged, to the effect that good telephone service could not be furnished at a less rate than the Bell company had been charging; but now that the Citizens' company, starting in without any experience, has demonstrated in less than a year that there is a good profit in the business at its cheap rates, the Bell company has come to the conclusion that it has already made so much money out of its exorbitant rates that it can do business now for nothing. What would our citizens think of any other business house or firm who, to crush out competition, offered its business free? The Citizens' company was organized to do business, giving its service as near actual cost as possible, with a fair margin of profit to its stockholders; but it has not laid up any money from exorbitant charges to fool away in giving free service. The Bell company announces that its free service will continue for a year. It might be pertinent to inquire, for the benefit of those of our citizens accepting free service, how long such service would continue in case the loyal patrons of the Citizens' company should abandon it and it could not continue in business, and what the rates of the Bell company would be in that case, bearing in mind the public statement made by Mr. Berry, the Bell company's local manager, to certain citizens when discussing the movement for a new company, that "There never can be more than one telephone company here, and you fellows who are doing the kicking will have to bear the loss, with good interest and book-keeping expenses besides."

George Cutter's Assignment.

The electrical trade was doubtless very much surprised to learn of the recent assignment of George Cutter of Chicago. For years Mr. Cutter has been looked upon as one of the best posted electrically, and one of the most conservative young business men in the West.

A representative of the WESTERN ELECTRICIAN called upon Mr. Cutter to ascertain the cause of the assignment. Mr. Cutter stated in his characteristic way that to him "it was a real-estate surprise party." The force of this remark will be appreciated from the fact that ever since the commencement of the depression in trade it has been generally known that Mr. Cutter had managed his electrical specialty business in a most careful manner and appeared to be running an establishment under a minimum of expense.

Mr. Cutter declined to talk further than to say that the business in his specialties will still be carried on in the name of the George Cutter company, with offices in the Rookery, Chicago.

Mr. Cutter was one of the pioneers in the electrical business. Educated most thoroughly in general electrical practice and scientific methods, as an expert for the original Thomson-Houston company, he was looked upon as one of its most gifted experts. In fact, the company showed its early appreciation of his talents by detailing him to go abroad in its interests. After an extended stay in foreign lands, he returned and was associated with S. A. Barton as electrician of the Thomson-Houston company's western department. After a most successful connection with the Thomson-Houston company, Mr. Cutter started for himself and achieved remarkable success as an "electrical specialist;" in fact it is safe to say that his clever and ingenious devices are now known wherever an electric light is in existence.

It is not at all improbable that Mr. Cutter will undertake the management of a central station, for which he is eminently fitted, and with a view of starting in the same locality a manufacturing enterprise to exploit his specialties.

Experiment in Municipal Ownership.

Another important step in the direction of municipal ownership has been taken in Liverpool, where, according to a London correspondent, the corporation has purchased the horses, vehicles, and good-will of the United Tramways & Omnibus company. The price paid was £567,375, on a basis of £12 and 15 shillings a share, or about 25 shillings more than recent market quotations. The municipality will operate the whole network of street-car lines and omnibus routes after August and endeavor to repeat Glasgow's experience in providing a sinking fund out of the profits for the repayment of the purchase fund and having a balance to turn into the city treasury.

Chas. J. Gruble, manager of the Inter-state Telephone company, Crawford, Neb., desires to correspond with telephone manufacturers for the purpose of getting figures on two small automatic exchanges.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 3.—In order to expedite the work of the Rapid Transit Commission, Assemblyman Austin has introduced a bill into the Legislature providing that the commissioners may, after obtaining the consent of the local authorities, advertise and let contracts and apply to the Appellate Division of the Supreme Court for compulsory consent of property owners. From a contractor the board may either accept a deposit of $1,000,000 as a guarantee, or may, if contracts are divided, take deposits of portions of that sum, but a failure to deposit the balance when required shall be a forfeit. The full amount need not be deposited until the consents of all property holders along the line have been obtained, and until 10 days thereafter. Mr. Austin says that the bill is intended to allow the board to lay out plans and do business prior to consents of property owners. An important decision was arrived at yesterday, when the commissioners agreed to the continuance of the tunnel road under Broadway from the City Hall to the Battery. According to the resolution adopted the road, south of Park place, will have two tracks, and its maximum width, except at stations, will be 25 feet. Property owners below Vesey street strongly opposed the underground road below that point. J. W. Alexander, representing the Equitable Life association, thought there was danger of the excavations weakening the foundation of the Equitable Life building. Mr. Parsons, however, convinced him that the engineering difficulties were merely nominal, because experience had shown that in an excavation in Boston adjacent to a six-story office building as near an approach as three feet to the building could be made.

The situation in relation to the affairs of the surface railway companies is unchanged. The Third avenue company has made a proposition to the aldermen that if the city buys in the Sixth and Eighth avenue lines under the terms of their charters (which provide for the acquirement of the roads for their cost with 10 per cent. added), the Third Avenue company will either buy the lines, paying the city the cost price, a bonus of $1,000,000, and five per cent. of the gross receipts thereafter, or it will lease them for a term of years, giving as rent 10 per cent. a year of their cost and five per cent. of the gross receipts. The matter was referred to the railroad committee. The newspapers report that the Metropolitan company sent 50 men on Wednesday night to lay its One Hundred and Sixteenth street tracks across Third avenue. The Third Avenue company, which had already got an injunction restraining it from doing this, had men on hand to prevent any contempt of court. The Metropolitan's men thought discretion the better part of valor, it is said, and the police had no trouble to keep the peace. The matter will be fought out in the courts.

Attention has been directed to Senator Timothy D. Sullivan's bill at Albany to incorporate the New York Electric Light & Power company, the incorporators being Reuben B. Ayers, Thomas B. Robertson and John B. Hawes. The objects of the company are said to be the manufacture, transmitting, conveying, using, selling, and supplying of electricity for heat, light and power in the city of New York. The capital stock of the company is to be $500,000, divided into 500 shares. The bill empowers the corporation to acquire and dispose of real estate and personal property, including the stock and franchises of other corporations, and to construct a system of subways or conduits across and through the streets, avenues and public places of the city, subject only to such reasonable regulations as to excavation as may be prescribed by the Department of Public Works or other officers having control thereof.

The Gravesend electric light plant, one of John Y. McKane's enterprises, which cost the projectors $119,000, has been sold at auction to the Brooklyn Edison company for $31,100.

The directors of the Consolidated Traction company, the New Jersey Traction company and the Newark Plank Road company met on Tuesday in the joint office of the three companies in Jersey City, and elected officers. Edward F. C. Young was elected president of the three companies, and all of last year's officers were re-elected. It was said that no dividend had been declared, as the directors proposed to use the profits in making improvements. President Young submitted a report showing that for the year 1896 the receipts of the consolidated lines increased nearly 10 per cent., while the percentage of operating expenses to receipts has been decreased nearly six per cent. There were 407 cars

operation during the year, and the numbers of miles run was 12,375,008. The increase in the number of passengers carried at the Pennsylvania ferry over 1892 was 17,466,455. Seven miles of track was added to the system, and the line connecting Newark with Jersey City over the turnpike road was completed. David Young, general manager of the Consolidated Traction company, proposes to unite the trolley lines from Orange, N. J., with lines in cities and towns on Long Island. He has submitted the plan to the directors of the company, and if it meets with their approval it will be put into effect early in the summer. The connecting link will be the boats of the Brooklyn annex ferry. The plan is to lay tracks from the Consolidated Traction company's terminus in Jersey City to the ferry slip, wire the boats, and lay tracks in each gangway. The Brooklyn Heights Railroad company will lay similar tracks to the ferry slip at the foot of Fulton street. By this means cars from the Oranges may be run without change to any point on the 250 miles of track on Long Island. It is not proposed to use the system at present for ordinary traffic but for the accommodation of trolley pleasure parties. The two gangways of the ferryboats will accommodate 10 trolley cars. M S.

Washington, D. C.

WASHINGTON, April 3.—The employes of the Ninth street division of the Metropolitan Railway company received an extra day's pay in recognition of their efficient service during the rush of inauguration week.

The Capital Railway company, chartered by the last Congress, expects to have the road in complete operation inside of 60 days. It will be operated on both underground and overhead electric systems, as the law forbids the erection of any overhead wires in the city limits. The road will run through the southeastern section of the city.

The jury in the case of the American Car company of St. Louis against the Washington & Georgetown Railway company returned a verdict finding for the plaintiff in the sum of $15,000, with interest from October 19, 1892. The American Car company claimed about $19,000 as the balance due on a contract to furnish a certain lot of cars. It was contended by the railroad company that the conditions of the contract were not fulfilled by the car company, and the suit resulted A few days ago the St. Louis Car company recovered $18,000 in a similar suit.

The Shenandoah County Telephone company of Woodstock, Va., has been chartered. Col. J C. Baker is the president; M. B. Wunder, vice-president; J. H. Grabill, secretary and treasurer. The company has purchased the line now running from New Market to Strasburg, and will at once place it in good working condition. New lines will be constructed until all the towns and villages of Shenandoah county are connected.

T. I. P.

PERSONAL.

John M. Orford, assistant general manager of the Boston Electric Light company, died on March 23d in his 54th year. He was a native of Scotland and had had an extensive electrical experience.

Frederic Nicholls of Toronto, president of the National Electric Light association, was a visitor at the New York headquarters last week. This was President Nicholls' twelfth visit to New York on association business since his election, making over 12,000 miles traveled by him in the interest of the association.

Among the out-of-town visitors registered at the headquarters of the National Electric Light association, New York, last week, were the following-named gentlemen: A. E. Carrier, Pittsburg, Pa.; Manuel Bruoet and Miguel Garcia, Havana, Cuba; D. D. Dickey, Pittsburg; A. J. Belden, Syracuse, N. Y.; N. H. Jones, Cleveland, O.; R. T. Robinson, Norfolk, Va.

The steamer New York sailed on Wednesday, March 31st, with quite a representation of the electrical business. Among those who embarked for Europe were President John A. Brill, of the J. G. Brill company of Philadelphia; General Manager H. L. Littell, of the Metropolitan Traction company, New York, and President Thomas A. Johnson, of the Steel Motor company of Cleveland, Ohio.

Theodore P. Cook has been appointed superintendent of the second district of the western division of the territory covered by the Western Union Telegraph company, with headquarters at St. Louis. Mr. Cook, who was formerly assistant district superintendent at Dallas, Tex., succeeds the late L. C. Baker, whose death was noted in the WESTERN ELECTRICIAN last week. He is an experienced and capable telegraph man, and his promotion is deserved.

The Chicago Edison club's banquet, which was to be given April 15th, was advanced to March 29th, with R. S. Kelsch, superintendent of the high-tension system and shops, as the guest of honor. Mr. Kelsch has resigned his position with the Chicago Edison company to accept the position of general superintendent of the Lachine Rapids Hydraulic & Land company of Montreal, Canada. As an evidence of the good will of the officers and employes of the company, Mr. Kelsch was presented a gold watch suitably engraved, a watch chain and a scarf pin. In departing from the company and Chicago, the superintendent leaves many friends, who wish him continued success.

ELECTRIC LIGHTING.

Michigan boulevard, Chicago, between Fourteenth and Thirty-ninth streets, is to be lighted by electricity, the old-fashioned gas lamps to be retired, just as they were some time since north of Fourteenth street. This change was agreed upon at a conference between Mayor Swift, Comptroller Wetherell and President Ellsworth of the South Park Board of Park Commissioners. The power will be taken from the city's electric light plant on Fourteenth street. Under an agreement the city bears the expense of lighting Michigan boulevard, except the cost of the ornamental poles, which is borne by the park commissioners.

ELECTRIC RAILWAYS.

A contract for the construction of an important electric railway in Mexico has been signed by C. E. Loss & Co. of Chicago, the amount involved being $400,000. J. B. Haggin of New York and General E. C. Frisbie of the City of Mexico are owners of the road, which will serve the city of Jalapa, near the port of Vera Cruz and connect the former with the towns of Huatusco and Coatapec. All the material, rails, wire, rolling stock and cedar poles are contracted for in this country. One obstacle to the electric conversion of horse and mule power street railways in Mexico is the scarcity of coal in the country. A water-fall will supply power for the Jalapa road, which will carry both freight and passengers.

TELEGRAPH.

Justice Shiras delivered the opinion of the Supreme Court in the case of the city of St. Louis against the Western Union Telegraph company. The case involved the right of the city to tax telegraph poles in the streets at the rate of $5 per annum each, and it was decided for the second time by the court. The decision of the court below, the Circuit Court for the Eastern District of Missouri, which was in favor of the telegraph company, was affirmed in the decision handed down on April 5th, on the ground that the questions raised by the city are not presented by the record. The court did not, therefore, go into the merits of the tax law at all

The Western Union and the Postal Telegraph companies have decided not to fight the license tax of $250 a year imposed under the recently revised city license ordinance at Kansas City, Mo. Their attorneys found a Charleston, S. C., case in which the courts held that a city had the right to require a license fee of telegraph companies doing business within its limits. It is said that cities all over Missouri and Kansas are now preparing to impose similar taxes, which will cost the companies thousands of dollars annually. The companies have up to this time maintained that their business was transcontinental and subject to interstate commerce laws only.

MISCELLANEOUS.

The Treasury Department is inviting sealed proposals for installing a system of electric wiring and interior conduits in the United States postoffice building at New London, Conn., and Youngstown, Ohio, bids for which will be opened on April 14th. Prospective bidders desiring specifications and blank forms of proposals for this work can obtain them upon application to the secretary of the treasury, Washington, D. C. Sealed proposals are being invited until April 21st for furnishing the United States mint at Philadelphia, Pa., with a quantity of electrical supplies, etc. Schedules of the supplies, together with the blank forms of proposals, may be obtained upon application to Herman Kretz, superintendent, Philadelphia, Pa.

TRADE NEWS.

S. F. B. Morse has resigned his position as general western agent for W. R. Brixey in the sale of the well-known Kerite products. It is reported that Kerite wires and cables will be handled in Chicago by J. B. Wallace. Mr. Morse will undoubtedly remain in the electrical business, in which he has a wide acquaintance and valuable connections.

Professor Louis B. Marks is on his way home from Europe, where he has been very successful in pushing the enclosed arc lamp to the favorable notice of scientists and dealers. The Electric Arc Light company of New York, of which Professor Marks is chief electrician, announces that on his return patent litigation will be vigorously prosecuted. It says that it has been lenient in the past, but will now make up for lost time.

Sealed proposal and bids will be received by the Board of Commissioners of the county of Allen, at Fort Wayne, Ind., until 2 P. M., on May 15th, for furnishing the material and work for the building of the new court-house and for the power station, including brick stack; tunnel; steam heating, including temperature regulation and forced blast system, ventilation, water-tube boilers and steam plant piping and sewerage and plumbing, including miscellaneous apparatus; electrical construction, including wiring sheriff's residence, jail, power station and tunnel, and electric elevators, automatic time system; engines and dynamos, and also alternate proposals for Corliss engines, belting and dynamos, for the county of Allen, according to the plans and specifications prepared by Brentwood S. Tolan architect. Copies of the drawings and specifications can be found at the offices of the architect, Fort Wayne, Ind., and of Pierce & Richardson, Chicago, who are consulting electrical and mechanical engineers for the architect. The court-house will be built upon the court-house square, in Fort Wayne, bounded by Calhoun, Berry, Court and Main streets. The power station will be built on the grounds lying immediately north of the county jail, on the west side of Calhoun street. The court-house and power station will be connected by a tunnel.

The trade mark "Asbestos," the address 87 Maiden lane and the name H. W Johns Manufacturing company, have been so long associated that the mention of one immediately suggests the other two to those who have been served by the varied manufactures of this company. The offices at 87 Maiden lane were established 25 years ago, and it is therefore after long hesitation that a change in address has been decided upon. Department has been added to department, and the trade has increased until each has assumed the proportion of a large business in itself and a removal has been absolutely necessary. The ground floor of the new Woodbridge building at William, John and Platt streets has been leased and is now being fitted up for salesrooms, accounting department and private offices and the basement for stock. It is to be one of the handsomest offices in New York, and with these increased facilities the company promises even more perfect service to its customers than in the past. The power of adapting inventive genius to practical purposes possessed by Mr. Johns, who is still the active head of the business, has rendered his discoveries of the peculiar and valuable properties of asbestos of much importance. The products of asbestos are now almost indispensable for household and mechanical purposes.

The new pocket handbook of the Standard Underground Cable company is now ready for distribution, and a careful investigation of the material contained between its covers will be time well spent. The present edition contains 182 pages and is an amplification of the handbook published in 1890, with necessary additions to bring contents up to date in every respect. The first 110 pages contain the price-lists of all material sold by the company, with complete description of all such articles in detail, and a handy telegraph code for the use of customers. The question of electrolysis is thoroughly discussed in an article by the company's electrician, giving the results of tests made in the laboratory and in actual commercial practice. Pages 111 to 126 contain instructions for installing all classes of cables and accessories. Methods of testing cables, locating faults, etc., are carefully discussed and explained with diagrammatic figures in pages 137-142. The remainder of the book contains many tables of general and electrical information, the tables on pages 161-162 giving complete data as to the diameter, weight and resistance of solid and stranded copper wire being especially complete. The information contained on pages 173 to 176 on the "Effects of Alternating Currents" and "Changes of Electrical Properties with Change of Temperature" are of particular value at this time. The general appearance of the book is very satisfactory, by reason of the neat binding and the high grade of the typographical work. The volume will make a valuable addition to any technical library, and its compact size renders it especially convenient for a pocket handbook. It is issued in three styles of binding, namely, morocco leather with pockets, flap and gilt edges, green vellum with pocket, flap and red edges, and brown vellum with round corners and red edges.

BUSINESS.

Bolts, screws and nuts are indispensable to electrical as well as all other mechanics and makers of machinery. The Cincinnati Screw & Tap company, established 23 years ago, caters to this trade and supplies, also, all kinds of mechanical tools and metal parts. A folder giving prices and detailed information is sent by mail.

General Agent J. P. Williams of the Paragon Fan Motor company of 39 Cortlandt street reports that the call for this fan has been entirely beyond expectations, so much so that two sets of men are working day and night to keep abreast of the orders. A new illustrated catalogue has just been issued, and it is filled with valuable information in regard to this product.

An attractive 16-page circular has just been issued by the L. E. Knott Apparatus company of Boston. In it the general problems of the influence machine seem to be discussed intelligently, and doubtless the publication will prove helpful to all interested in the subject. In the new machine described every precaution seems to have been taken to protect the working parts from moisture and to secure easy adjustment. It can be operated either by hand power, incandescent lighting current or water motor. The instrument seems to present many novel features never before used on any form of influence or static machine.

The Lundell fan motors, manufactured by the Interior Conduit & Insulation company of New York, are so well known that a description of them would seem almost superfluous. These machines have been sold all over the world, and the name "Lundell" has become identified with a high standard of merit. The company has placed upon the market this season several new styles of ceiling and column apparatus, and its handsome illus-

trated catalogue shows a varied and complete line. The Lundell is not a cheap affair, but is a machine well made in every particular, handsome in design and finish, and of an efficiency said to be the highest obtainable.

Carlisle & Finch of Cincinnati report that they are busy filling orders for their electric toy novelties, their specialty being miniature street railways. They will soon put on the market a fine line of novelties, such as hand dynamos, boats, inclined planes, etc. They are rapidly coming to the front as western manufacturers of high grade search-lights for river and lake steamers, and have recently secured several large orders.

K. McLennan & Co., Chicago, sole manufacturers of Gale's commutator compound, state that there are few power and central stations or isolated plants throughout this country and Canada that are not at this time using Gale's commutator compound. However, they will continue to furnish free sample sticks to the few who have not tried it. They have in contemplation the publication of 2,000 reports from the use of Gale's commutator compound, and they ask all who are now using this compound, who have not reported to them the results of their trial, to do so at once, so that a report may be inserted in the forthcoming pamphlet. Free samples of Gale's commutator compound may also be obtained of all supply houses.

An instrument in which electric light men are taking much interest is the Chapman direct and alternating current voltage regulator, put on the market by the Belknap Motor company, Portland, Me. It is designed to give steady light from unsteady power, and the manufacturers claim for it many points which will appeal to the modern superintendent. The Chapman regulator for varying-speed dynamos is said to solve a question of great importance to users of electric light. Central station people are fully aware of the importance of unvarying voltage, and it is claimed that only with the aid of the Chapman regulator is it possible to give an absolutely steady light. This useful instrument was described in the WESTERN ELECTRICIAN of March 27th. The Belknap Motor company will give further particulars on request.

The Electric Storage Battery company has recently contracted to install a battery of chloride accumulators in the Queen's Insurance company's new building, corner of Cedar and William streets, New York. During the day the battery will be operated as a regulator of potential, allowing the elevator and lighting services to be taken from one generator, and during the night and over holidays and Sundays the battery will furnish all the current required by the lamps and elevators. Other contracts recently closed cover batteries for supplying night lamps and elevator service in the building being erected by Jones Bros., Brooklyn, which plant will be operated at 240 volts throughout; a battery for lighting the casements at Fort Wadsworth; another for use in connection with the gas engine dynamo plant to be installed for St. Paul's Methodist Episcopal church, New York; a battery for night lighting and lamp testing at the lamp works at Harrison, N. J. The Commercial Cable company is installing a battery of chloride accumulators in its new building, to be used for operating its ocean cables. Chloride accumulators are being installed, also, upon several yachts.

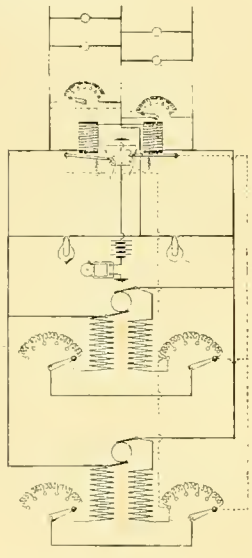
The Westinghouse Electric & Manufacturing company has succeeded in constructing an alternating current fan motor for the season of 1897 that bids fair to become one of the most popular fan motors of the coming season. This motor is of the induction type and differs somewhat from the mechanical proportions of the fan motors of recent years in being smaller and lighter. It retains the feature that was introduced in the Westinghouse fan motor of last year and which was found of great practical value; that is, "speed variable at will," which is effected by the use of a three-contact switch of simple construction located in the base of the fan motor. By means of this switch the motor may be run at full speed, at moderate speed, or it may be cut out of the circuit. When the motor is running at full speed the breeze of air supplied is strong, steady and of wide range. When running at moderate speed, the motor successfully meets the requirements of the best desk fan, the breeze being considerably reduced and the current required to drive it being materially less. The motor is especially useful in a sick room or a bed room at night, securing effective circulation of air and operating almost without noise. This fan motor has neither a commutator nor brushes, and weighs complete, ready for service, 25 pounds.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued March 30, 1897.

579,556. Multiple Series System of Electrical Distribution. Francis B. Badt, Chicago, Ill. Application filed January 25, 1897.

It is proposed in a system of multiple series distribution to have the combination with main and compensating conductors of an undivided source of electricity from which the main conductors are led, and means adapted to respond automatically upon a variation in potential between a compensating and a main conductor to reduce the electromotive force of the generator.



NO. 579,556.

579,576. Trolley Wheel Frame for Trolley Cars. William Grunow, Jr., Bridgeport, Conn. Application filed May 8, 1896.

A tangential trolley wheel frame is adapted to be connected with the trucks of a car, and is provided with trolley arms or levers pivotally connected therewith, each of which is in operative connection with a transverse lever, the transverse lever being in operative connection at one end thereof with a main operative lever.

579,582. Electric Meter. George Hookham, Birmingham, England. Application filed September 18, 1896.

This is an electricity meter for continuous currents, in which the motor armature is immersed in mercury and rotates together with the brake in the field of a permanent magnet, and in combination, the brake magnetic pole-pieces arranged in parallel with the motor magnetic pole-pieces instead of in series, so that the passage of the current is across the armature from side to side instead of from side to center to increase the driving force, and the armature provided with slits, the armature being filled in at the slits and coated on both sides with non-conducting composition, only the periphery being left conducting to limit the path of the current across the disk.

579,611. Electric Heater. William R. Smith, Manchester, N. H. Application filed June 11, 1896.

An electrical resistance is composed of a single jointless piece disposed in two helices of opposite pitch, one within the other.

579,633. Telegraph Transmitter. Charles L. Buckingham, New York, and Joseph Gardam, Brooklyn, N. Y. Application filed September 2, 1896.

Provision is made for a motor, a train of gear, circuit-controlling devices for directing signaling currents to line, a toothed regulating wheel connected with the gear, a spring, a heel-piece, a bracket and a set-screw.

579,634. Printing Telegraph. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. Application filed August 28, 1896.

Messages are printed upon a paper tube; a row of holes is perforated in the tube parallel with its axis, a spur-wheel meshing with the row of holes, and an auxiliary wheel within which the spur-wheel is journaled.

579,635. Printing Telegraph. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. Application filed September 3, 1896.

Claim is made for the combination of a stationary support, paper tube, step-by-step or escapement wheel, train of gear, feed-wheel, manual disconnecting apparatus, cam, means for lowering the cam through the manual disconnecting apparatus, and means whereby the wheel may be raised and lowered.

579,636. Printing Telegraph. Charles L. Buckingham, New York, and Emil Germann, Brooklyn, N. Y. Application filed January 5, 1897.

The arrangement includes a message-blank formed into a paper tube, having a row of equidistant holes parallel with its axis, a tubular support having circumferential and diagonal grooves, a slot across the grooves lengthwise of the tube, a gear-train for rotating the paper tube, a motor for driving the train, an escapement therefor, means for disconnecting the escapement wheel from its pallets, and a setting-arm which is moved within the teeth of the wheel while the latter is in line with the slot, and which is moved away from the teeth of the wheel when it is desired to insert a new message blank.

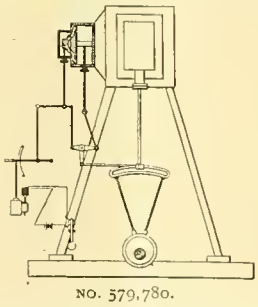
579,699. Microphone. Arthur W. S. Davis, Lowell, Mass. Application filed April 30, 1896.

In a microphone the combination with a casing having a central aperture a transverse groove and a diaphragm, of a button, an adjusting screw for the button, and a curved flat spring lying in the groove for supporting the button.

579,700. Device for Relieving Pressure in Boilers. John G. J. Davis, Augusta, Ga. Application filed June 9, 1896.

Electric contacts are connected with the scale beam of the safety valve, and an arm connected therewith for automatically closing the circuit when the valve opens to exhaust steam, and thereby cause the bell to operate.

579,707. Electrical Generator. Samuel V. Essick, Yonkers, N. Y. Application filed May 14, 1896.



NO. 579,780.

A single fluid cell, comprising an external conducting vessel, an element of a more positive metal inserted therein, an electrolyte containing a salt of copper, a holder containing a supply of the salt of copper, means for feeding the salt to the electrolyte as required, and means for externally heating the cell.

579,725. Insulator and Holder for Electric Railways. Willie C. Keitbly, San Francisco, Cal. Application filed November 27, 1896.

This device consists of a metallic cap of the form of a frustum of a cone, an interiorly secured correspondingly shaped insulator, a shank having wings for securing the same to the insulator, whereby the trolley wire is suspended therefrom, oppositely disposed hooks upon the top of the cap adapted to receive the transverse supporting wire, having a groove or channel in the top of the cap, in which the wire lies between the hooks.

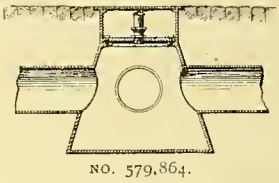
579,739. Electric Railway. Frank Mansfield, New York, N. Y. Application filed August 4, 1893.

A contact device suspended from the car consists of a short conducting bar supported horizontally beneath and between the axles of each truck, and an intermediate conducting bar hinged between the short bars.

579,760. Electric Railway. Frank Mansfield, Philadelphia, Pa. Application filed August 13, 1895.

A car is provided, with a magnetic contact device carried a considerable distance above the ground for attracting and holding the circuit-completers in magnetic and electric contact therewith, and a set of magnets arranged at the end of the contact device for gradually raising the circuit-completers into contact with the contact device.

579,780. Electrical Governor for Marine Engines. George A. Tower, Richmond, Va. Application filed March 18, 1896.



NO. 579,864.

The features described comprise the combination with a marine engine, a reversing link connected to the slide valve thereof, an auxiliary cylinder and piston, and means connecting the piston to the reversing link, an auxiliary valve controlling the admission of the steam to the auxiliary cylinder, an operating lever, and means for connecting it to the auxiliary valve and to the devices for shifting the link, of a supplemental cylinder and its piston, this piston being detachably connected to the operating lever, a balanced valve controlling the admission of fluid to this cylinder, a solenoid or magnet controlling this valve, and a circuit closer.

579,790. Mouthpiece for Telephones. Casper L. Cohn, Boston, and Morris Martin, Malden, Mass. Application filed December 11, 1896.

A frusto-conical or cup-shaped mouthpiece lining is described, comprising a liquid proof external section, and an absorbent inner section secured to the interior of the outer section, and fastening devices for attachment to a correspondingly shaped mouthpiece.

579,864. Subway Junction Box. George C. Deake and George N. Moore, New York, N. Y. Application filed June 30, 1896.

The combination is claimed in a subway box, of the inner lower water-tight cover, the loose top cover and the duplex gas relief valve in the lower cover, the valve adapted to first open the vent into the valve chamber, and later open the vent from the chamber.

579,916. Battery Cover. Horatio J. Brewer, New York, N. Y. Application filed October 2, 1896.

A battery cover is provided with an opening, through which the upper portion of one element of the battery is adapted to pass, and a piece adapted to fit the opening in the cover, and provided with a slot at one end adapted to fit a battery element, whereby the battery jar is closed and the element supported in position.

579,929. Electrically Controlled Railway Signal. Frank McBrien, Newark, N. J. Application filed September 3, 1896.

A plurality of insulated track sections, each normally charged with current, a plurality of signal stations, each containing two independently operated signal devices controlled respectively by two relays in series relation to one another and charged by the track circuit, one relay having a greater number of ampere-turns than the other, and means for varying the strength of current to the track circuit when a train passes determinate points of the track.

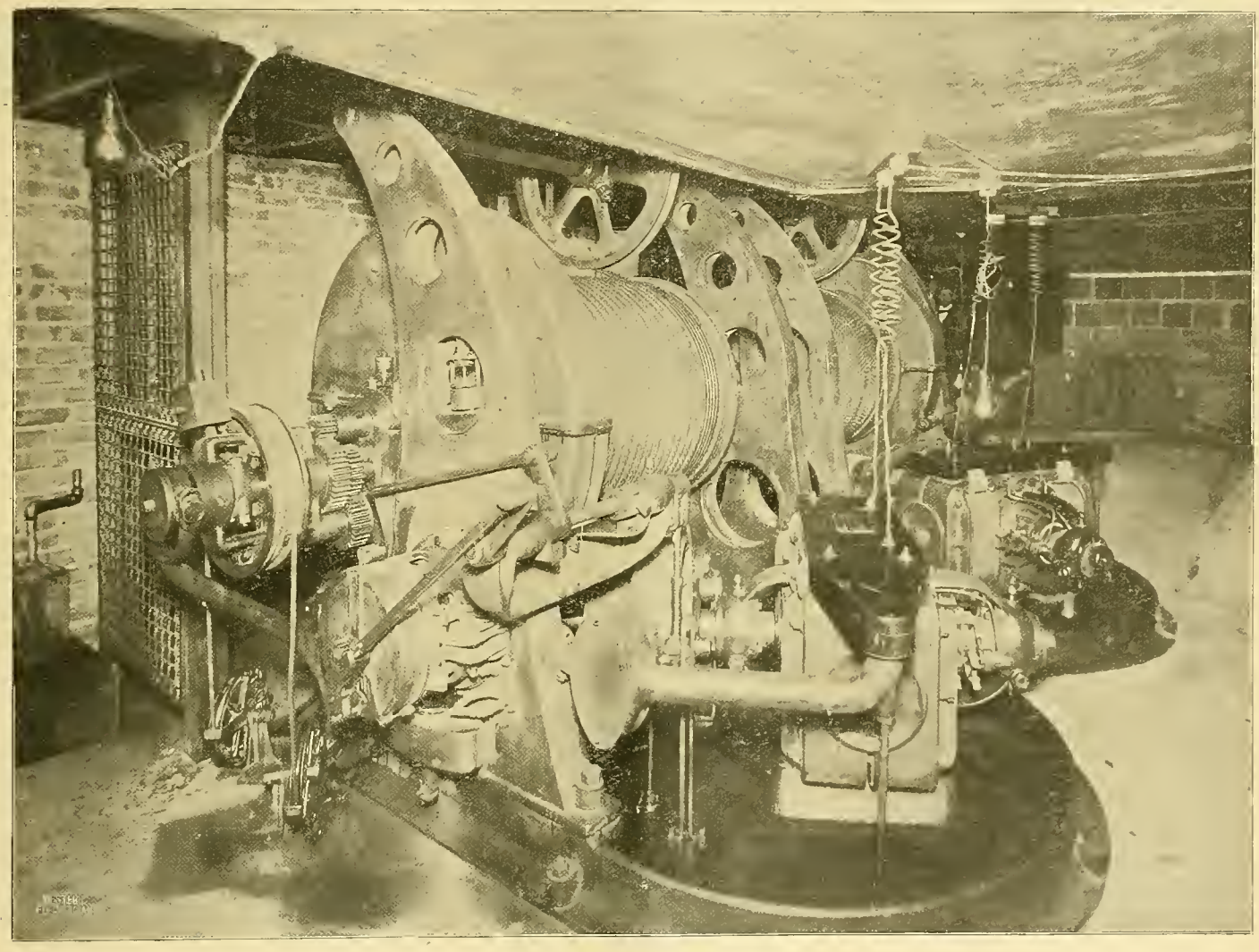
579,933. Signaling. Jens G. Schreuder, Edgewood Park, and John P. Coleman, Swissvale, Pa. Application filed August 26, 1896.

An electrically controlled connection is established between the signal and its lever, a circuit for the mechanism, an electrically controlled indicator, the operating magnet of the indicator being included in the circuit, a branch circuit including the armature of the indicator magnet, a make-and-break mechanism controlled by train movements arranged in the main circuit, and a second make-and-break mechanism in the main circuit and controlled by the signal lever.

Western Electrician.
EVERY SATURDAY.
Vol. XX. CHICAGO, APRIL 17, 1897. No. 16

Electric Elevators in the Trude Building.

In the new Trude building at Wabash avenue and Washington street, Chicago, there are three interesting electric elevators of a new type. Two of the elevators are for passenger service, with a vertical travel through 10 stories, and one is for freight. The electrical equipments for the two passenger elevators, which are shown in the illustration, occupy but little space in the basement. The current for the elevators and also for a 10 horse power Gibbs motor used to drive a deep-well pump and a house pump is taken from the street mains of the Chicago Edison company.



ELECTRIC ELEVATORS IN THE TRUDE BUILDING.

This elevator equipment was built by the Standard Elevator & Manufacturing company of Chicago under the patents of Frank B. Rae and the mechanical design and improvements of T. W. Heermans, engineer of the Standard company. The two passenger machines are designed for maximum load of 3,000 pounds and to carry 2,250 pounds at a speed of 250 feet per minute, the rise being 135 feet. The freight machine, which is of the same general type, so far as the electrical and mechanical construction is concerned, is for a maximum load of 4,000 pounds, with a speed of 190 feet per minute when carrying 3,000 pounds, the total rise being 146 feet. The elevator motors are rated at 15 horse power at 220 volts.

The Standard company's motor, as designed by Mr. Rae, is thought to be a step in advance in the matter of economy of operation, particularly from the fact that the starting current, whatever the load put upon the car, cannot at any time exceed 35 amperes, and also from the elimination of any external resistance and the absence of electrical or other apparatus usually employed for cutting in and out such resistance.

The operation of any elevator at full speed and full load is obviously a question of the total efficiency of the system, and does not differ materially in any of the electrical elevators, although some gain in this particular is claimed for the Standard machine by reason of the higher efficiency of the spiral gear used by Mr. Heermans in place of the usual worm gear. With low starting current, and therefore high economy of power required to start and accelerate the load, the total output of energy for a given duty is undoubtedly less than in a machine requiring larger starting current.

The theory of the motor of the Standard elevator is thus explained by Mr. Rae: "It is well known that the starting effort of any motor is dependent finally upon the amount of magnetism or the number of magnetic lines that are passing through the magnetic circuit of the machine. Where the field magnetism is fixed and the increased magnetism required for starting is produced in the armature part alone, it must be at the expense of a large current flowing in the few armature turns; and to obtain this necessary current safely resistances must be introduced into the armature circuit. Such resistance is of course wasteful of energy during the time it is in use; the large current required to produce the necessary armature magnetization during the period of acceleration is repeated at each time the machine is called upon to start its load, and this results in a very large expenditure of energy for this purpose. In the Standard machine the starting torque is produced almost wholly by field magnetization and is accomplished by the use of a large number of turns, carrying a comparatively small current, and these turns are gradually cut out of circuit as the armature comes up to speed, at which time the field magnetization is maintained by a shunt winding designed to maintain the armature at full speed and at full load. In other words, the starting torque is due to the magnetization of the field coils of both a series and shunt winding, while the running torque is maintained by the shunt winding only."

Another valuable feature claimed for the Standard company's machines is that with the low starting torque the lighting mains are unaffected by the initial current taken by the elevator, and that where such mains are small this starting current can be reduced to 25 amperes at 220 volts.

Articles of incorporation were filed last week at Springfield for the North Shore Interurban Railway company. The capital stock is $340,000. The new line will be operated by electricity and will connect Waukegan with Highland Park. A. D. Wheeler, one of the incorporators and the attorney for the Chicago capitalists who are behind the project, announced that work would in all probability be commenced within six weeks. The new road will have at first no street railway connection with this city, but will depend upon the interurban traffic.

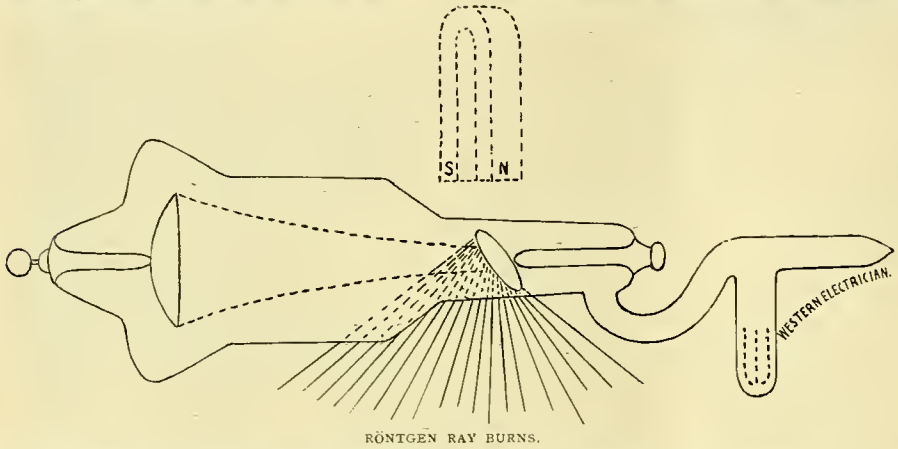
Röntgen Ray Burns.

By Elihu Thomson.

The cause of the injury to the skin which follows an exposure to a source of Röntgen rays is still a subject for discussion. It is known that a comparatively short exposure at sufficiently small distances from the source will produce the effect. It has been claimed by some that Röntgen rays do not produce the mischief, but that the effect is essentially electrostatic. Others have expressed the opinion that ozone and other substances present in the neighborhood of the excited tube are the real causes of the injury.

It has seemed desirable to set at rest, by experiment, these doubtful theories. The very peculiar nature of the injury itself, its course of development, the accidental circumstances under which it has occurred, have all tended to negative any theory except that which regards rays from the tube as the true cause. These rays might be either Röntgen rays, or rays so closely analagous as to be with difficulty distinguished therefrom.

The first effect after exposure is a slight reddening of the skin, which is made more easily discernible by a little friction over the spot affected. This lasts two, three or more days and tends to fade. In the writer's experience, at the end of a week there has been an almost complete absence of any noticeable effect on the skin. On the ninth day, however, the affected part was found to redden, and this increased for a few days until blistering and sloughing took place with slow and tedious healing. These effects were noted in the case of the exposure of the little finger of the left hand and are at present writing in progress upon a portion of the third finger of the same hand, in consequence of an exposure for only 12 minutes to the rays from a special tube. This tube was made for the purpose of obtaining strong effects by lessening the working distance from the bombarded spot on the platinum, which is the source of the rays.



RÖNTGEN RAY BURNS.

The cut on this page shows the general form of the tube. It is narrowed around the platinum anode and the glass is also made thin around the same. It is thus possible to get the finger, the fluorescent screen or the photographic film very close to the bombarded spot on the platinum anode. The distance need be not over one-half an inch as a minimum. By the use of a magnet the spot on the platinum could be shifted so as to be very close to the glass and upon the edge of the platinum sheet. The intensity of the radiation per unit of surface was increased thereby, according to the law of inverse squares, which seems to hold in this case. This use of the magnet is indicated in dotted lines, and is very convenient for directing the cathode rays upon any part of the platinum anode, which might in fact be faced with a variety of different substances, or have its surface differently formed or curved at places, while the cathode beam could be directed first to one part and then to another and the effects noted. If a platinum anode has been perforated by the beam at one point, the tube is still useful, for a slight effect of the magnet puts the beam upon a new surface. Many a good tube may thus be made to do service even after several holes have been melted through the platinum sheet.

With such a source of rays as the tube illustrated it was easy to try an experiment, the result of which seems to the writer to leave no doubt of the fact that Röntgen rays, or rays of the same general characteristics, do actually cause the burns and injury which may follow prolonged exposures to the Röntgen radiation. The left hand was covered with a lead sheet of over one-sixteenth inch in thickness, and an oblong hole of about three-fourths of an inch long and about five-sixteenths inch wide cut through it at the part just over the third finger, between the first and second joint. This limited the passage of rays to the part of the finger under the opening. But around the finger and under the middle of the opening was placed a strip of heavy tinfoil about three-sixteenths inch wide. This divided the exposed area into two parts. One of these parts in turn was covered with two layers of thin aluminum leaf gummed to the finger. Thus there were in fact three spots on the finger within the opening, one covered with aluminum foil or leaf, another with heavy tinfoil and the third left entirely bare. The opening in the lead sheet was brought close to the platinum anode, so that the finger was about five-eighths inch distant from the bombarded spot.

The exposure was for a period of 12 minutes, which it was thought would be sufficient. The result at first was two faintly reddened spots, one having the outline of the part under the opening in the lead shield covered by the aluminum foil, and corresponding thereto, and the other corresponding to the bare spot. Under the tinfoil strip there was no action. These reddened spots, though scarcely visible, could be developed by slight friction, but gradually faded, until, at the end of a week, from the time of exposure, they were with great difficulty distinguishable from the rest of the skin, even after the spot was rubbed. On the ninth day, however, they returned, and the spots became painful and a little swollen. This has continued to increase and will probably end in blistering, sloughing and final healing. The part covered by the tinfoil is sharply marked from the others, being entirely unaffected. The effect produced through the aluminum leaf is about the same as on the bare spot, showing that thin aluminum does not stop the rays which produce harm.

It is needless to say that the effect is proven by the experiment to be neither electrostatic nor ozonic, but merely a result of certain rays reaching the skin surface, and such rays are probably those of the Röntgen rays not readily absorbed. According to the law of inverse squares an exposure of 12 minutes five-eighths inch distance would require, at 10 inches distance, for equal effects, about 50 hours, or over two days. There is, then, no occasion for any alarm at the effects of Röntgen rays, as exposures of sufficient duration to produce harm are rarely, if ever necessary. In regard to the claim which has been made that injury only follows exposures made by induction coils, while static machines do not produce the effect, it may be said that in the writer's former experiment, of which the little finger was made the subject, a large-capacity static machine was used, and the result was severe enough. The present experiment was made with an induction coil as the source of electric discharges, and as yet there is no difference in the results. The effect is now, of course, limited to two small spots a little distance apart.

Canadian Electrical Association.

It is expected that the meeting of the Canadian Electrical association, to be held at Niagara Falls, Ont., on June 2d, 3d and 4th will be a notable gathering. The first two days will be given up to routine convention work, while the third day will be devoted to sightseeing and visits to the great power houses on the American side of the river. On the evening of June 3d a banquet will be given in Dufferin Cafe, Canada side, on which occasion there will be a grand electrical display. Manager Phillips of the Niagara Falls Park & River Railway company has agreed to furnish the necessary current.

O. V. Steckert is an applicant for an electric light franchise at Northwood, Ia.

Transmission of Heavy Currents.

By Dr. G. H. B. Zahn.

In all electric light and power plants the conductors are the important medium between the places of generation and consumption of electricity. To insure proper transmission of an electric current two things are required—the use of a conductor and the employment of an insulating material.

Iron and copper have always been used as the most suitable metallic conductors, but the question of securing a proper insulation of these metals has for a long time been a difficult one.

In the earliest days of experimenting with electrical currents, wires suspended on silk threads in the open air were considered sufficiently insulated. But this method became utterly impracticable as soon as the advancement of electrical science necessitated more extensive wire systems. About a century ago the proposition was made to place the electrical conductors underground in insulating tubes or conduits made of glass or clay, and one of the first underground systems was successfully used by Ronalds in 1816. Schilling and Soemmering insulated wires with wax or shellac, and they were the first to employ wires covered with silk as an insulator. In 1837 conductors covered with cotton, coated with shellac and placed in iron pipes were used by Cook and Wheatstone of England. The apparent intention in these early days was to place the wires underground, and the question of proper insulation seemed to be solved when in 1848 gutta-percha was first employed. Since it possessed all the properties of the long-sought-for insulator, it seemed to become the insulating material of the future. Nevertheless, for various reasons rubber-covered wires did not prove very successful at that time, and the idea of placing electric conductors underground was abandoned. Overhead or air-lines were established and rapidly extended, while in a few instances only—especially in cities—underground rubber-covered cables were used.

The year 1880 marked the beginning of a new period in the manufacture and development of insulated electric wires and cables, caused by the demand of the rapidly growing number of light and power plants. The good insulating properties of a great number of materials were already known, and silk, cotton, jute, shellac, tar, resin, asphalt, rubber, etc., were principally used. It had also been proven that lead-covered cables were impregnable to dampness, and that a covering with iron wire or band afforded a safe protection of the insulation against outside damage.

The years following saw some changes in the use of a number of insulating materials as well as in the manufacture of cables, and rubber, the best of insulators, has largely given way to paper, a cheap but most suitable substitute.

In Germany determination of the dimensions of conductors for electric light and power purposes is in every instance made a matter of very careful calculations, since it is an acknowledged fact that the distributing system of conductors constitutes not only a most important, but in a great many cases also the most expensive part of an electric light and power undertaking, and that it has just as much to do with the economic working of a large plant as the efficiency of boilers, steam engines and dynamos. The manner of laying underground wires has nevertheless a good deal to do with the more or less careful plotting out and calculating of a network of conductors. In Germany iron-armored underground cables are generally used that are placed between tiles, or in a layer of sand between bricks, or in wooden conduits which are subsequently filled with asphalt. In England and America this system has not come into great use, while the conduit or so-called drawing-in system has been widely adopted. Conduits made of cast-iron and vitrified clay have proved to be most successful; steel does not withstand the humidity found underneath the street surface.

The easy manner in which the drawing-in system allows the replacing of small cables by larger ones or the laying of additional conductors as soon as the current supply increases is generally the cause of the minor importance given to the cable problem in the instance of establishing a new plant.

In planning a network of electrical conductors for the supply of light and power, three points have to be taken into consideration:

a. The safety of the system or the safe carrying capacity.

b. The good working considered from the point of regulation.

c. The economical dimension of the conductors.

It is evident that in dealing with the problem it is not always possible to give each of these three conditions the same weight, but first of all the safety is to be considered; second, the good working, and, finally, the question of economy or the economical carrying capacity.

To avoid undue heating of the conductors a certain current strength per unit of area must be observed. Although it is hard to tell what the limits of current for different sizes of wire should be, one thing is understood, that the current per unit of area should be in relation to the diameter of the conductor. This is easily seen, since the cooling surface of a large wire is relatively smaller than the one of a wire of a smaller diameter. In determining the size of electric conductors this fact is taken into consideration, and the formula $I = c\,d^{\frac{3}{2}}$ is generally adopted, giving the relation of the current I to the diameter of the wire d; c is a coefficient, varying according to the increase of temperature allowed and outside influences. There is no doubt that in all countries general rules will be established determining the carrying capacities of wires and cables. The present rules are mostly given by the underwriters, and although they contain some discrepancies and are in several points a little behind the progress of electrical engineering, they are rightly observed. In all these rules the safe carrying capacity of wires is considered of the greatest importance as a safeguard against undue heating and danger of fire.

When a current is passing through a conductor its temperature rises until it becomes stationary. The increase of temperature is proportional to the energy—watts—lost in, and inversely proportional to the cooling surface of the wire. In other words:

$$\text{Increase of temperature} = \text{coefficient} \times \frac{\text{watts lost}}{\text{cooling surface}}$$

If t stands for the temperature increase in degrees of the centigrade thermometer, C_1 for the coefficient, W the watts lost, and S for the conductor surface in square millimeters, we may write

$$t = C_1 \frac{W}{S}. \qquad (1)$$

The value of C_1 varies not only for different materials (metals) and surface conditions of the conductor, but changes also with the material and thickness of insulation and the conditions of laying the wires. It can be determined in the following way: The energy in watts lost in a wire is

$$W = I^2 R \text{ (Joule's law)},$$

where I stands for the current in amperes and R for the resistance in ohms. For the resistance R we may write:

$$R = \frac{l\,\omega}{A}$$

L being the length, A the cross-section of the conductor, while ω stands for its specific resistance (resistance in ohms for one meter of length and one square millimeter of cross-section at 15° C).

The watts lost are then:

$$W = \frac{I^2\,L\,\omega}{A}$$

The (cooling) surface of the conductor is determined by its length L multiplied by its circumference B. If L is given in meters and B in millimeters, the cooling surface in square millimeters is

$$S = 1000\,L\,B,$$

and substituting the values of W and S in the formula for t we may write

$$t = C_1 \frac{I^2\,L\,\omega}{1000\,L\,B\,A}$$

or expressing $\frac{C_1}{1000} = C$, to simplify the formula—

$$t = C \frac{I^2\,\omega}{B\,A} \qquad (2)$$

From this formula, that gives the increase of temperature (C°) of a conductor as a function of the current, the cross-section, circumference and the conductivity, it is possible, taking an admissible or safe increase of temperature into consideration, to find the values of the safe carrying capacity I, the safe cross-section A and the safe loss of voltage.

The safe carrying capacity is

$$I = \sqrt{\frac{t}{C}\,\frac{A\,B}{\omega}} \qquad (3)$$

The safe carrying capacity per unit of area

$$D = \sqrt{\frac{t}{C}\,\frac{B}{A\omega}} \qquad (4)$$

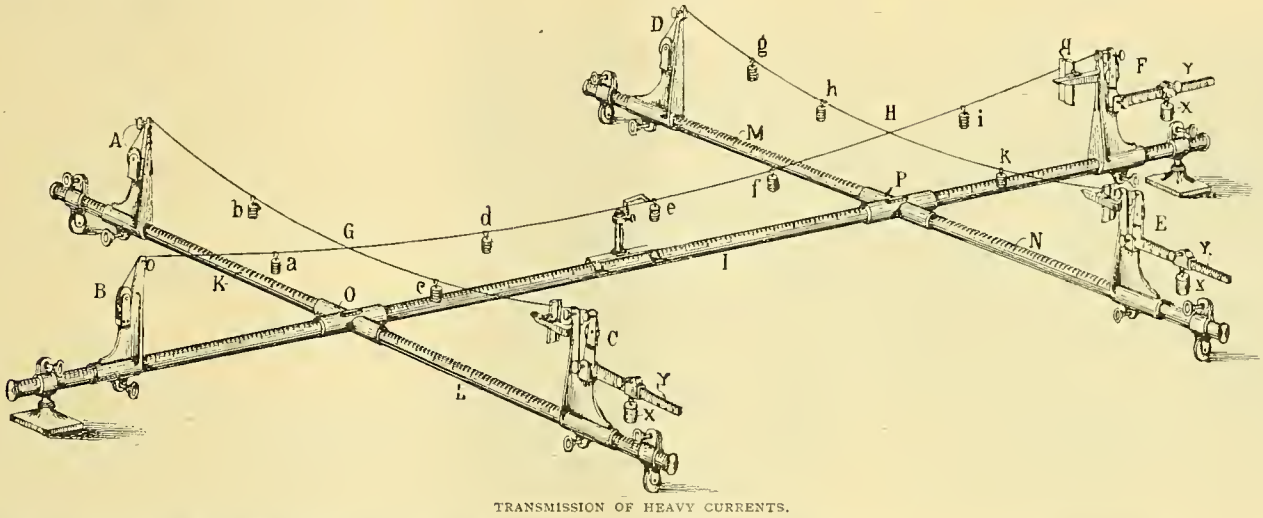
The corresponding cross-section

$$A = \frac{C}{t} I^2 \frac{\omega}{B} \qquad (5)$$

The corresponding safe loss of volts

$$\left(e = I \frac{L\,\omega}{A} \right)$$

$$e = L \sqrt{\frac{t}{C}\,\frac{\omega\,B}{A}} \qquad (6)$$



TRANSMISSION OF HEAVY CURRENTS.

These formulæ (2 to 6) hold good for conductors of any shape of sectional area. In most cases we have to do with a circular area, and if the diameter d is given in millimeters, we have

$$B = d\pi,\ A = \frac{d^2\pi}{4},\ \text{and}\ B = \sqrt{4\pi A}$$

By substituting these values in formulæ 2 to 6 we find for circular conductors:

The increase of temperature

$$t = \frac{C\,I^2\omega}{\sqrt{4\pi}\,A^{\frac{1}{2}}} \qquad (2a)$$

$$t = \frac{4}{\pi^2} C \frac{I^2\omega}{d^3} \qquad (2b)$$

The safe carrying capacity

$$I = \sqrt{\frac{\sqrt{4\pi}\ t\,A^{\frac{3}{2}}}{C\,\omega}} \qquad (3a)$$

$$I = \sqrt{\frac{\pi^2}{4}\,\frac{t}{C}\,\frac{d^3}{\omega}} \qquad (3b)$$

The coefficient of heating C has under various conditions been determined by Prof. Grassi. The results are given in the following table containing the values of

$$C^1 = \frac{4}{\pi^2} C\omega$$

found experimentally, and the calculated values of

$$C = \frac{\pi^2}{4}\,\frac{C^1}{\omega},$$

where $\omega = 0.0175$. The table shows that the heating coefficient is of a greater value for bare than for insulated copper wires, and that it is the smaller the heavier the insulation.

Although the heating coefficient C is smallest for heavily insulated wires, it is not advisable to allow a greater carrying capacity for them than for bare copper wires, as the insulation may be easily damaged by heating.

TABLE I.

Condition of Conductor.	Diam. in mm. Bare wire.	Diam. in mm. Insulated wire.	Coefficient C¹ Determined experimentally.	Heating coeffic. $C = \frac{\pi^2}{4}\frac{C^1}{\omega}$ Calculated.
Covered with green silk...	1.05	1.20	0.178	25.033
Bare copper wire.....	1.05	.....	0.208	29.253
Bare and polished wire....	1.05	.....	0.214	30.097
Rubber covered wire.....	0.70	1.40	0.0908	12.770
Rubber covered wire.....	1.60	2.70	0.183	25.737
The same placed in wooden conduit.....	1.60	2.70	0.180	25.315
The same wire cotton covered.	1.60	3.20	0.190	26.720
Wire insulated with cotton, rubber, cotton and sbellac.....	0.80	4.00	0.0797	11.209
The same in wooden conduit.....	0.80	4.00	0.0932	13.108
The same, but cover removed from conduit.....	0.80	4.00	0.0855	12.025

Taking C = 32, *i.e.*, a value that is somewhat greater than any one in the table, and allowing an increase of temperature of 9° C. or 16.2° F. over the surrounding air, we find for the foregoing formulæ:

$$\frac{t}{C} = \frac{9}{32} = 0.28;\ \frac{C}{t} = 3.55;$$

$$\sqrt{4\pi}\,\frac{t}{C} = \frac{3.545}{3.55} = 1;\ \frac{\pi^2}{4}\,\frac{t}{C} = 2.4674 \times 0.28 = 0.693\ (= 0.7)$$

$$\frac{4t}{C} = 1.125;\ \frac{C}{\sqrt{4\pi t}} = 1;\ \frac{4}{\pi^2}\,\frac{C}{t} = 1.45;$$

and for circular conductors

The "safe" carrying capacity

$$I_s = \sqrt{0.693\,\frac{d^3}{\omega}} = \sqrt{0.7\,\frac{d^3}{\omega}}\ \text{(about)}.$$

The corresponding current per unit of area

$$D_s = \sqrt{1.125\,\frac{1}{\omega d}}$$

The "safe" cross-section

$$A_s = \sqrt[3]{I^4\,\omega^2}$$

The "safe" diameter

$$d_s = \sqrt[3]{1.45\,I^2\omega}$$

The "safe" volt loss

$$e = \sqrt{1.125}\,\frac{L}{\sqrt{\frac{d}{\omega}}}$$

For t = 9° C., $\omega = 0.0175$ at 15° C., and C = 32. The following tables give the values of I_s, D_s, e_s:

TABLE II.

Diameter of wire d	Cross-section A	Safe carrying capacity I	Safe carrying capacity per unit of cross-section.	Safe volt loss per m.
mm.	mm².	Amperes.	Amperes per mm².	Volt.
1.0	0.785	6.32	8.01	0.140
1.5	1.767	11.60	6.54	0.114
2.0	3.142	17.87	5.66	0.099
2.5	4.909	24.97	5.06	0.089
3.0	7.069	32.82	4.62	0.081
3.5	9.621	41.36	4.28	0.075
4.0	12.566	50.53	4.00	0.071
4.5	15.904	60.29	3.78	0.067
5.0	19.635	70.62	3.58	0.063
5.5	23.758	81.47	3.42	0.060
6.0	28.274	92.83	3.27	0.057
6.5	33.183	104.68	3.14	0.055
7.0	38.485	116.99	3.03	0.053
7.5	44.179	129.75	2.93	0.052
8.0	50.265	142.93	2.83	0.050

TABLE III.

(Conducting.) Cross-section of wire cable.	Circumference of wire cable.	$I_s = V\frac{t}{C}\frac{AB}{\omega}$ for t = 9° C.; C = 32.	$= V\frac{t}{C}\frac{B}{A\omega}$	$e_s = V\frac{t}{C}\frac{B\omega}{A}$
mm².	mm.	Amperes.	Amp. per mm².	Volts per m.
25	20	90	3.6	0.063
35	24	116	3.3	.058
50	29	152	3.0	.053
75	35	205	2.73	.048
100	40	253	2.53	.045
125	45	300	2.4	.042
150	50	346	2.3	.039
175	54	388	2.22	.038
200	58	430	2.15	.037
250	65	510	2.04	.035
300	72	588	1.96	.034
400	82	725	1.81	.032
500	92	860	1.72	.030
600	101	985	1.64	.029
700	108	1,100	1.57	.028
800	115	1,213	1.51	.027
900	120	1,320	1.47	.026
1,000	125	1,420	1.42	.025

From tables II. and III. it can be seen that the safe carrying capacity of a wire cable is somewhat larger than of a wire of the same useful cross-section. This is due to the fact that the circumference and therefore the cooling surface of a wire cable is greater than of a wire of the same area.

If the current is increased 1.5 times, the correspond ing rise of temperature will be $1.5^2 = 2.25$ times the former or 20° C. (36° F.), so that for an outside temperature of 30° C. (86° F.) the temperature of the conductor would be 50° C. (122 F.). To an increase of current $= 2\ I_s$ a rise of temperature of 36° C. (65° F.) corresponds, and for an outside temperature of 30° C. the temperature of the conductor would be 66° C. (151° F.), and therefore above the melting point of some insulating materials.

To prevent undue accidental heating of electric conductors automatic magnetic safety devices or fusible cutouts of lead or lead and tin are generally used. It may be mentioned that fuses should be sufficiently long (5 to 7.5 centimeters or two to three inches) to prevent transmission of heat from the middle of the fuse wire to binding posts, etc., and thus insure their proper working at the passage of a current they are intended to protect against. It should also be remembered that fuse wires enclosed in glass or porcelain tubes require a greater amount of current (45 per cent. about) to melt than the same wire placed in the open air.

The dimensions of a conductor are generally determined by taking an admissible loss of volts into consideration and comparing the calculated cross-section of the wire thus obtained with its safe carrying capacity. If the calulated value is too small, it has to be increased in conformity with the underwriters' rules, and the loss of voltage then decreases correspondingly.

In small isolated plants and house circuits the conductors are mostly dimensioned for a constant current per unit of area, the safe carrying capacity rules being observed at the same time; the feeders of extensive wire nets in large plants are of a constant cross-section from the station to the feeding points.

The three-wire system is especially adapted to an economical and extensive distribution of electrical currents. The voltage is twice as great as in a two-wire system, while the current is only one-half. Taking in both cases an equal loss of volts into consideration, the weight of the two outside wires in the three-wire system will therefore be only one-quarter of the other; the middle wire has about one-half of the cross-section of the outside wires, so that in a three-wire system $\frac{5}{16}$ of the copper weight of a two-wire system is used.

In a five-wire system the voltage is four times greater and the current four times smaller than in a two-wire system. The second and fourth conductors have one-half, the third wire one-quarter, of the area of the outside wires. The total copper weight is therefore $\frac{13}{128}$ of the two-wire and $\frac{1}{10}$ of the three-wire system.

The five-wire system is very seldom used. Although the cost and weight of the copper are reduced to about one-tenth, the reduction is not so great for insulated cables, while the cost of putting the conductors underground is materially increased. If, finally, the difficulty of proper regulation is considered, it is easily understood why five-wire systems have not come into greater use.

In places where, on account of the great distance of the plant from the different points of supply, the three-wire system is out of the question, the alternating current system has advantageously been employed. The working of this system is well known. The low-tension windings of the transformers connect either directly with the house branches or they supply a secondary network of street conductors. In the first place the transformers are placed in the buildings that are to be supplied with current; in the latter they are housed in small sub-stations.

A three-wire distributing system with alternating current transformers is especially adapted to the latter case, since it can be obtained with the use of but one transformer and three binding posts—on both ends and the middle—of the secondary winding. However the load in the two circuits thus obtained may vary, each circuit is entirely self-regulating and independent of the other.

Whatever system may be chosen the maximum volt loss must not be so great as to impair the proper working of incandescent lamps if the load changes between its extreme limits, and the volt loss in the mains should, therefore, not exceed two per cent., while the loss in the feeders may be as high as 15 per cent.

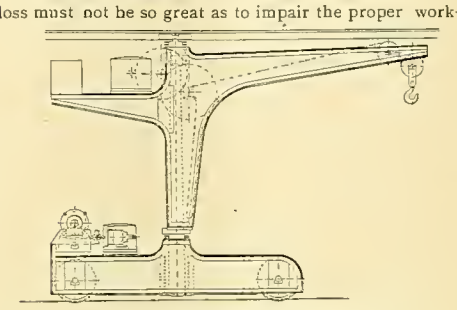


FIG. 2. SEMI-ELECTRIC AND OTHER SHOP CRANES.

The places of supply of current and the course of the streets determine the form of a network of conductors in a city. The number and location of feeder points in the wire system require careful attention. If only the weight of the copper were to be paid for, a great number of small feeders would be the most advantageous, both from the view of the regulation as well as low first cost. But to the price of the metal the cost of insulation and the expense for placing the conductors underground are to be added, which items are relatively high for cables of small size. It is not advisable to place positive and negative feeding points closely together, as in that case the losses in both the positive and negative main conductors would increase with the increasing distance from the feeding points; in fact, the losses in the two mains would be added together. This can be easily avoided by connecting the feeders to the negative mains at some distance from the positive feeding points; *e. g.*, should the mains form a closed (ring) circuit, the positive feeding point should be diametrically opposite to the negative one.

To calculate the diameter of the mains of a wire system the location of the feeding points and the current strength at these points must be known. The distribution of current in a system can only be found after the dimensions of the conductors are known, and that fact greatly complicates the calculations. The only thing to do is to choose a certain distribution of current by dividing the whole network of wires in as many parts as there are pairs of feeding points and by cutting all mains in two, so that we have to deal with a number of independent branch circuits. The dimensions of these circuits are then calculated for constant cross-section, a certain loss of volts being taken into consideration. All main wires constitute one large network of conductors, and certain conditions must be fulfilled to insure a proper working; not too many different sizes of cables should be used; the fluctuation of current in the mains and of the voltage at the feeding points should not affect the most sensitive apparatus connected to the main circuits, *i. e.*, the light of incandescent lamps; provision should be made that the system may be easily extended; and even if a feeder must be cut out, for any reason, that should not impair the efficiency of the main system.

That it is impossible to consider all these points in planning a great cable system is easily understood. Every change in the size of a conductor will change the distribution of current, and if it is desired to find out whether the very important conditions of safe carrying capacity and practicable loss of volts are complied with, the actual distribution of current has to be determined. That can be done by:

1. Calculation.
2. Electrical measurements on a model.
3. Mechanical measurements on a model.

The great number of complex quantities make the first method by means of calculation a rather complicated one. Several modes of carrying such calculations out have been given by Herzog, Herzog and Stark, Coltri, Hochenegg and Teichmueller, but they are too long to find any further mention here.

After the distribution of the current in the mains and the load at the different feeding points has been determined by the way of calculation, the dimensions of the feeders are found by applying the general rule given by Thompson; it must be considered, however, that the loss of voltage should be the same in all feeders. Where it is impossible to comply with these conditions on account of too great a current per unit of area, the same volt loss can be obtained by putting a proper resistance in the feeder line.

The calculation of a network of feeders and mains is very instructive, especially if the distribution of current at different loads and for different cross-sections of conductors is considered, since it gives an idea of the working of one of the most important parts of a large light or power undertaking.

The second method of determining the dimensions of the feeders and mains of a cable system is by means of a model representing on a small scale the electric plant in question. The resistances of the conductors as well as the lamps, etc., are given in the model as about one per cent. of the actual values to be met with in the plant, and when a battery, representing the dynamos of the

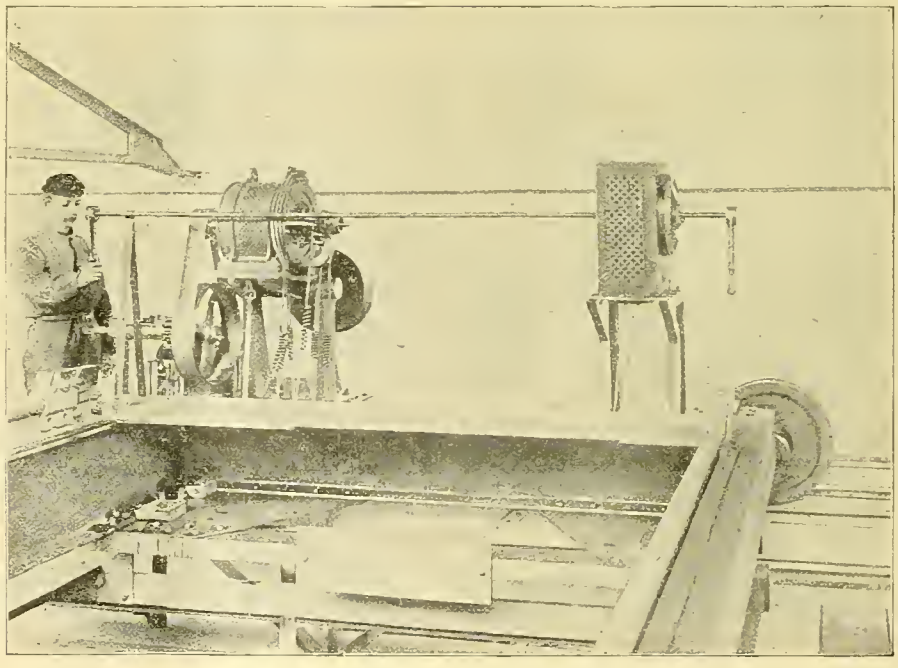


FIG. 1. SEMI-ELECTRIC AND OTHER SHOP CRANES.

station, is connected with the terminals of the model, a current distribution is obtained that is directly proportional to the one of the plant. It is now possible to experimentally determine the difference of the voltage between the various feeder points and the branch circuits supplying the lamps, etc., thus giving an exact idea of the volt loss and the current in the different parts of the network.

This method has the great advantage that the loads at desired points and the cross-sections of conductors can be easily varied, but the high price of such a model seems to prevent its use even by large light and power plants.

The third method, which is illustrated in the cut on page 216, has been invented by Mr. Helberger and makes it possible to determine the sectional area, drop of voltage and distribution of current in a network of wires by mechanical measurements.

Experiments showed that the behavior of a thread or wire suspended at two points and loaded with weights is the same as that of a wire to which current is supplied at its two ends and from which current is taken at several intermediate points. This fact has been made use of in designing the apparatus illustrated for determining the cross-section of cables and the study of the conditions in a network of conductors.

It consists of several cylindrical graduated rails which can be connected crosswise together. On each of these rails two movable supports are mounted which carry the other parts necessary to adjust the threads and read off the results; a number of weights and an arrangement to determine the dip of the thread are also supplied. *AC*, *BF*, *DE* represent distributing mains; *A*, *B*, *C*, *D*, *E*, *F* are feeding points to the same, while *a*, *b*, *c*, *d*, etc., are points where current is taken off, the amounts of the current being indicated by weights.

The movable supports are arranged on the rails in such a manner that their relative distances correspond with the lengths of the mains between the feeding points; they are then connected by threads which are loaded with weight proportional to the amount of current supplied at distances proportional to the relative distances of these delivery points.

The sliding weight on the lever carried by the support is then adjusted until the dip of the thread corresponding to the drop of potential does not exceed a certain amount at any point

The position of the sliding weights then affords a measure for the sectional area of main necessary, while the angle of declination of the thread from the horizontal indicates the distribution of the total energy. This angle is read off directly on a small scale mounted on the lever support. The dip can be adjusted for various losses of potential, and, like the weights, is calibrated from carefully tested units.

The results obtained are said to be quite satisfactory, and the price of the model is not so high as to prevent its use in plants, offices or colleges.

Mr. Arnold's Work.

In a letter to the WESTERN ELECTRICIAN relating to the course of Arnold lectures, Prof. Arthur Edwin Haynes of the University of Minnesota has this to say of the author: "He was once a pupil of mine in mathematics, and I have watched his splendid progress with unwavering interest and pride since he began his career as an engineer. He is a graduate of Hillsdale College, my alma mater, and was graduated while I was in the chair of mathematics and physics of that institution. A biographical sketch of him, I am sure, would prove of interest to the readers of the ELECTRICIAN. As an undergraduate he was of much promise, and even then possessed rare mechanical skill and judgment."

For the information of Prof. Haynes and other inquirers it may be stated that a brief biographical sketch of Mr. Arnold, with portrait, was given in the WESTERN ELECTRICIAN of May 25, 1895. He has done much important work since then, however, such as perfecting his power station system, conducting the important trade which resulted in the absorption of the Pumpelly-Sorley Storage Battery company by the Electric Storage Battery company, and installing the Board of Trade and several other plants. Much of this work has been reported in the WESTERN ELECTRICIAN from time to time. The details of the storage battery transaction, for instance, were given at some length in the issue of November 2, 1895.

The Wells, Minn., electric light plant is being run to its full capacity, and if the call for lights increases more an enlargement of the plant will be necessary.

Macintire Enclosed Arc Lamp.

In the restaurant of J. Kamsler at 713 Broadway, New York, there is located an installation of enclosed arc lamps manufactured by the International Arc Lamp company, which has offices at Houston and Mercer streets, New York. These lamps have attracted much attention, because of the new departure which they permit in interior lighting by arc lamps, as shown by the illustration. Attached to ceiling are six Macintire lamps, with a drop of only 19 inches, and of this three inches is taken up by the canopy. The bulb enclosing the arc is shaded from below by a regular incandescent lamp shade, and surrounding the bulb is a handsome ring of crystal prisms connected to an ornamental canopy, as shown. These lamps take 80 volts and are run from the Edison mains. The resistance in circuit with each lamp is mounted on the switchboard and does not in any way interfere with the lamp. The general effect of these lamps is very artistic and ornamental.

The short length of this lamp adapts it particularly for interior illumination and house lighting, and it can be used with success for ship and marine lighting. The marine type of lamp is 16 inches long and takes but little more space than the incandescent lamp. The bulb is protected by a wire screen and can be shifted from one position to another when it is necessary. There are several styles for street illumination, invented by G. R. Macintire. Among them is one that is especially designed for use as a street lamp-post. This lamp is mounted on the top of the post, but the lamp mechanism proper is placed in the lower section near the ground, and can be easily got at by opening a cover in the post. A slender rod connects the mechanism with the carbons in the bulb and regulates their position perfectly. Several of these ornamental lamp-posts have been installed in New York, and have received praise for their artistic beauty and the lighting effect

MACINTIRE ENCLOSED ARC LAMP.

The Macintire lamp for use among photographers is especially commended, as the diffusion of light from this lamp is claimed to be stronger and to cover more surface than any other lamp manufactured. The International Arc Lamp company is now perfecting arrangements to take care of a large amount of business, and expects shortly to locate selling agencies in the leading cities of the country.

Fatal Over-confidence.

Familiarity breeds contempt, and contempt of high-tension electric wires, unfortunately, occasionally leads to death. Eternal vigilance is the price of safety; but this is such a trite truism that it is often ignored; and then, after hundreds of chances carelessly and successfully taken, comes one where the conditions are fatally perfect, and there is a dead man and a house of mourning. A sad illustration is afforded by the death of the electrician of Schlesinger & Mayer's store in Chicago. The man was young and newly married. He had been employed in the establishment for some time and must have been throughly familiar with the condition of the wiring. His death seems to be due to a lack of caution in the presence of a known danger. The circumstances are set forth by the *Tribune* in the following paragraph. The warning conveyed is obvious.

Charles Landhon, an electrician employed in the store of Schlesinger & Mayer, State and Madison streets, was instantly killed at 6:30 o'clock last evening by an electric shock. Just before closing time a break in the current put out a number of the electric lights in the building, and Landhon went to the basement to locate and repair the trouble. He finally located the break in a network of wires nearly in the center of the basement ceiling, and, tools in hand, climbed up to repair it. The cloak-rooms in the basement were crowded with men and women clerks, while scores of others were in the main basement waiting their turn to dress. Fully 100 employes watched Landhon as he climbed upa step-ladder. Having reached the top, he stretched out his hand and took hold of one of the wires. As his hand touched the wire he uttered a cry of pain and fell from the ladder to the floor. Women screamed and ran from the room with their hands over their faces. Engineer Anderson ran to the side of Landhon and attempted to assist him. He raised the body in his arms, but a hasty examination convioced him that life was extinct.

Semi-electric and Other Shop Cranes.[1]

By R. GRIMSHAW.

The illustration (on page 216, Fig. 1) shows a crane in the locomotive repair shops of the Saxon governmental railways at Dresden, which, from the peculiar character of its drive, might be called "semi-electric." The crane is run along the ways by electric power from a three horse power Siemens & Halske motor, driving through belts and gear-wheels to driving wheels at each end of crane girders. The load, however, is hoisted and lowered, and the cat or trolley bearing the hoisting works given its traverse by hand power actuating through chains. The reversal of the motor is effected from either platform of the crane, as shown in the illustration. The purely mechanical part of the design and construction was carried out by C. E. Rost & Co., Dresden.

Fig. 2 shows a velocipede crane with electric drive for both hoist and run. On the shop floor there is a single rail to guide the crane in its course up and down, or forward and backward, as it might more properly be called. Overhead, the guide-wheel runs between two parallel rails. There is, on the back-balance arm, a motor which guides the hoisting gear through toothed wheels; and on the platform back of the swing post there is a separate motor which drives the running gear through a worm and worm-wheel. This crane has 3,000 kilogrammes, equal to 6,600 pounds, lifting capacity, and three meters, equal to 10 feet, hoist. Both motors are reversible, each with its own reversing switch, but there is one rheostat for starting both.

This crane is in the shops of the "Societe Anonyme des Aociens Ateliers de Construction van den Kerchove"—more commonly known to and easily remembered by Americans as the Vandenkerchove shops in Gans, or Ghent, or Gent, according as that rich and enterprising Belgian city is called by its French or English, or German and Flemish name. It is in these shops that the Wheelock engine and the Cresson friction coupling are made.

I should have mentioned that this crane was built by the firm of Ludwig Stuckenholz of Wetter, on the river Ruhr, the motors being of the Siemens & Halske type.

There is a semi-electrical velocipede crane in the main shops of the Baden governmental railways, in the city of Carlsruhe. This was originally a Ramsbottom endless rope crane, but has been rebuilt for electrical drive. On the column is a six horse power electric motor with vertical shaft, which drives the vertical shaft of the crane that formerly received its rotation from the endless rope. From this vertical crane shaft the load-hoisting and lowering, and the crane-motion to and fro on the track, are taken by frictional device. The column is swung round by hand.

Santa Barbara, Cal., is said to have the proud distinction of being the home of a motorwoman who operates the machinery of an electric car. The woman's name is given as Hattie Miller, and it is said she likes the work.

1. From *Machinery*.

Western Electrician

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CIRCULATION, 16,630.

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AMONG the patents issued last week and reported in this issue of the WESTERN ELECTRICIAN was one granted Thaddeus Cahill of New York upon the "Art of and Apparatus for Generating and Distributing Music Electrically." The specifications form a comprehensive treatise upon the subject, and the claims allowed, numbering 175, seem to cover every feature of the art.

TELEPHONE companies operating in the Empire state are going through their annual experience with the Legislature. The usual bills have been introduced providing for the regulation of the rates of service, etc., and the committees having the measures in charge are complying with the formality of listening to arguments on the proposed law. It would appear to the unprejudiced observer that the Bell interests could afford to make a considerable reduction of their rates if they did not have this annual legislative drain upon their resources.

SUCH organizations as the Texas Gas and Electric Light association, which will hold its annual meeting at San Antonio next Tuesday, is worthy of encouragement and support. The society is composed of business men who have pride in their calling and are ambitious and industrious. It is the purpose of the organization to promote the interests of the members, improve their social relations and secure co-operation in the advancement of the general welfare of the lighting companies of the state. We congratulate them upon their prosperity, individually and collectively.

AN electric railway, whose lines extend beyond the confines of one state, comes within the jurisdiction of the interstate commerce commission and is subject to the provisions of the "Act Regulating Commerce." This is the decision of a majority of the commissioners in the case of Charles M. Wilson against the Rock Creek Railway company of the District of Columbia. Doubtless there are many more electric railway systems that come under the provisions of this measure, and the management of these lines would do well to consult the terms of the interstate commerce bill.

COMMISSIONER BUTTERWORTH, who has just entered upon his duties in the Patent Office, will find that the business of that branch of the government has greatly increased since his last term. The retiring commissioner of patents has proved a faithful and efficient officer, and has done much to improve the service and expedite the business of the Patent Office. The carefully trained force that has been organized under civil service regulations has aided materially in executing the policy of the head of the department, and Mr. Butterworth will doubtless find the office in excellent condition.

ETERNAL vigilance is required about an electric generating plant. A Chicago engineer, who ranks high in the profession, recently visited a lighting station in which he is interested, and, while helping the men employed about the dynamo room, got a shock of 2,000 volts. Happily the current did not pass through his body, the circuit being completed through his hand. He was engaged in straightening the blades of a switch when the accident happened. The thumb of his right hand rested on one blade while the little finger was pressed against the other. He was badly burned, and for a time his hand and wrist were completely paralyzed.

PUBLIC sentiment in Ohio is divided on the question of electrical executions. When the law was enacted the prison officers found it difficult to purchase the necessary apparatus, as the manufacturing companies were averse to having their machinery used for such purposes. The experience of Ohio in this respect was a repetition of that of the New York state prison officials several years ago, when a similar law went into effect in the Empire state.

At Columbus last week all the arrangements had been made for the first execution under the new law, and the final test of the apparatus was being made prior to the actual use of the equipment for the destruction of life, when the plant failed. On examination it was found that the armature of the dynamo had burned out, and although the employes undertook to replace it in time for the execution, the prison officers refused to allow the change to be made in such short time, fearing a repetition of the accident, and the governor was induced to grant a respite.

As a result of this accident there is grave doubt in the mind of many prominent citizens as to the advisability of inflicting the death penalty under the new law. It is believed that a repetition of the accident of last week will result in the speedy repeal of the electrical execution law.

DURING the present session of the New York Legislature several bills have been considered providing that the price of gas shall be reduced. One of these measures has received the support of the republican statesmen at Albany, and another has been advocated by the forces of democracy. Neither of the bills appears to be worthy of the support of conservative men. The theory upon which the movement back of these bills is based is utterly wrong and illogical. The practice of appealing to a meddlesome legislature for redress of every petty grievance, real or supposed, is un-American. There is bound to be a reaction. Even at the present time there is evidence of revulsion of feeling, just as there was upon the question of municipal ownership of lighting and street railway plants. It is worthy of mention that the arguments that were used in advocating the latter projects are again brought out to do duty in behalf of the "gas bills." Chief among these is the claim that such measures are for the greatest good for the greatest number. But this line of reasoning, followed to its logical conclusion, would lead to such mischievous interference and so affect property rights as to produce a state of anarchy. There is no danger of such condition of affairs, for the people will recognize the fact that great injustice is being done and will speedily correct the evil.

ATTENTION has already been directed to the controversy over the franchise secured by the Canadian Niagara Power company from the commissioners in charge of the Victoria Park and to the opposition that has been developed against an extension of time being granted the company in which to begin operations. In April, 1892, the Canadian Niagara Power company was given an exclusive franchise for the development of power in Queen Victoria Niagara Falls Park, which is on the Canadian side of the river at Niagara Falls. This franchise is for a period of 20 years, with option to extend it for a century. In payment for the franchise the Canadian Niagara Power company is to pay an annual rental of $25,000 for the first 10 years, which amount is to be increased $1,000 per year for the following 10 years, until at the end of the twentieth year the rental would reach $35,000 per year, at which figure the company may renew the franchise for 80 more years by giving proper notice. This franchise gives the Canadian Niagara Power company exclusive control of the development of the power of the Niagara on the Canadian side, and as the Canadian Niagara Power company is practically the same as the Niagara Falls Power company, owners of the big tunnel power plant on the American side of the Niagara, it gives what is practically one company control of the Niagara power development to a very large extent. Under the franchise the Canadian Niagara Power company was to commence work on or before May 1, 1897, "and to have proceeded so far with the work on or before the first of November, 1897, that they will have completed water connections for the development of 25,000 horse power and to have actually ready for use, supply and transmission 10,000 developed horse power by the last mentioned day." Some months ago the company made application for an extension of time in which to commence work, and in the report recently submitted to the Ontario Legislature, the commissioners of Victoria Park recommended that the extension be granted, and it is believed that the action of the government of the province will be favorable.

WHAT will be the effect of the municipal elections upon electrical interests in Chicago? There seems to be a general impression that the newly elected mayor will be much more favorable to corporations operating under public franchises than would either of the independent candidates, had one of them been elected. Candidate Harlan, who received the next highest number of votes, made a strong plea for popular favor by his opposition to the street railway companies of the town. It was known, too, that Mr. Hesing had pronounced views upon the question of compensation for public franchises. According to the daily papers, the republican machine was not on friendly terms with the street railway companies. In view of these facts the election of Mr. Harrison must be considered as favorable to these corporations.

In the aldermanic contests the same questions proved an important factor. The Municipal Voters' League canvassed the records of the aldermen seeking re-election, and in several cases the reports which were published by that body were instrumental in defeating candidates who were commonly known as "boodlers." Five republicans, six democrats and three independents in whose favor the league exerted its influence were returned to the City Council, and it is thought that these aldermen, together with the little band of reformers who held over, will prove an effectual check upon the boodle element in the new board. The practice of granting valuable franchises to straw companies has become a favorite method of levying blackmail in this town, and it may be difficult to dissuade aldermen who have become accustomed to it, from indulging their propensity in this direction; but it is to be hoped that the practice will be made unprofitable as well as unpopular by the newly elected members.

Much has been said during the last few months about "franchise grabbers," and this class of individuals has been severely denounced. If the new administration possesses the wisdom which the experience of its leaders would indicate that it should have, it will realize that the encouragement or sanction of such schemes will result in disaster as great as that which the republican machine has just experienced.

Swenie Calls Halt in Barrett's Department.

[From the *Chicago Record* of April 12th.]

In all departments of the city there is a rule that purchases of supplies for amounts over $500 must be made by contract with the lowest responsible bidders in public proposals. Due notice must be given through the newspapers of the proposed purchase, and specifications furnished to firms desiring to bid. This rule grew out of an ordinance passed with reference to the Department of Public Works, the operation of which has been extended to all the departments by every administration for a period of 10 years or more.

Prof. J. P. Barrett of the city electrical department has admitted there is an evasion of this regulation in his practice of splitting the vouchers for purchases in excess of $500 into amounts falling below $500. The invoices are adjusted in accordance with the practice, dates being altered when necessary. Prof. Barrett stated that it was not practicable to obey the regulation in the matter of all purchases, and that the splitting was done to comply with the letter of the law. The official record of the department, however, gives numerous cases where the regulation has been directly violated, the vouchers exceeding $500 for single purchases, where no contract has been let.

An examination of the vouchers of the City Telegraph Department for 1896 shows purchases amounting to about $10,000, which were made in actual or practical violation of the $500 regulation, and its purpose of securing supplies from the lowest responsible bidders. The list of firms benefited includes, according to the official records, the Metropolitan Electric company, S. F. B. Morse (western agent for Day's Kerite wire), John A. Roebling's Sons company, the Police Telephone & Signal company, Washburn & Moen Manufacturing company and William Mueller & Co.

In February, 1896, the Metropolitan Electric company was paid a voucher of $1,052.44. Of this amount four items for wire purchased in January make up $805.69. The invoices are dated on four successive days, and thus at first glance seem to show four separate purchases. The order number on each, however, is identical, and each sheet is marked "All aerial construction" and signed "H. Leser," the only invoices so marked that month. The invoices are as follows:

January 22—Order No. 17610, 5 mi. No. 12 Tr. Brd. wire, requisition 8924	$175.00
January 23—Order No. 17610, 5¾ mi No. 12 Tr. Brd. wire, requisition 8924	201.25
January 24—Order No. 17610, 1,184 lbs. No. 12 bare wire, requisition 8924	189.44
January 25—Order No. 17610, 1,500 lbs. No. 12 bare wire, requisition 8924	240.00
Total	$805.69

There is no contract with the Metropolitan Electric company on file.

In May six distributing boxes for underground cable were purchased of this company at a cost of $522.50, the item being paid in a voucher of $747.58. The invoices are as follows:

May 15—Two distributing boxes (60 and 30 conductor cable)	$170.00
May 15—One distributing box (60 and 30 conductor cable)	60.00
May 21—Three distributing boxes	292.50
Total	$522.50

John A. Roebling's Sons company has several vouchers for purchases over $500, and no contract is filed for them. In May one was paid for $706.12, for No. 12 hard-drawn copper wire at 13¾ cents, and all delivered at the city repair shops at Rice and Lincoln streets. The three invoices show the same order number, as follows:

May 2—Order No. 9030, 30 coils	$282.49
May 14—Order No. 9030, 24 coils	211.20
May 22—Order No. 9030, 23 coils	212.43
Total	$706.12

The same company has another voucher for $728.81, paid in November, for No. 12 weather-proof copper wire at 16¼ cents, billed as follows:

November 12—Ten miles	$290.39
November 13—Fifteen miles	438.42
Total	$728.81

The invoice of the Police Telephone & Signal company shows some queer changing of dates. Three bills are made out and dated with type-writen lettering and figures, and the dates, which were all alike, have been altered in heavy red pencil so as to be distributed over the month. The voucher for the purchases, which were three joker outfits, was $975. Following is the manner of the alterations:

July 31 (original date) July "3" (red pencil date)	$325.00
July 31 (original date) July "21" (red pencil date)	325.00
July 31 (original date) July "27" (red pencil date)	325.00
Total	$975.00

Another voucher of this company for $850 is invoiced as follows:

October 5—1 private joker	$125.00
October 11—1 Eng. house joker	325.00
October 16—1 private joker	125.00
October 22—1 private joker	125.00
October 23—1 chemical register	150.00
Total	$850.00

Washburn & Moen have a voucher for $718.03 for two lots of No. 12 copper wire at 13¾ cents. The dates are different by a day, but the first order of the two seems to have been received last, as follows:

August 31—Order No. 9164, 25 miles	$359.77
September 1—Order No. 9163, 25 miles	358.26
Total	$718.03

In October lumber was purchased of William Mueller & Co. to the amount of $536. The original dates of the two invoices were alike, and one is changed a month ahead, with blue pencil, as follows:

October 8 (original date), November 8 (blue pencil), order No. 9033	$356.00
October 8 (original date) order No. 9033	180.00
Total	$536.00

S. F. B. Morse has three large vouchers in addition to a number of small ones. One of these, for $1,176.60, is charged to a contract for cable, dated October 21, 1895. The specifications for that contract state that the cable advertised for was "Day's Kerite lead-covered cable." Morse is the only man in the West who handles that wire, and he has been getting nearly all the city trade. His bid of 80 cents a foot for 60 conductor cable was the only one submitted.

Two other vouchers of $876.80 and $1,710.63 are charged against a contract of September 21, 1896. The invoices are for two lengths of 60 conductor cable, the contract for which he secured at a price seven cents a foot higher than the next highest biddder, and 24 cents higher than the lowest bidder. Morse's prices ranged higher than those of his competitors on five sizes of cable. On the opening of bids it it was proposed to give him the entire contract, but the Standard Underground Cable company, the lowest bidder, made such a disturbance in the electrical trade that the contract for the four smaller sizes was given to that concern. The figures at which Morse was favored and the other bids were as follows:

	Price per foot.— 60 cond.	40 cond.	30 cond.	20 cond.	10 cond.
Name.					
S. F. B. Morse	$ 8244	$.6411	$.5075	$.3643	$.2225
Standard Underground	.58	.442	.365	.29	.196
Edw. Lasselt & Co.	.68	.50	.41	.30	.18
Safety Insulated Wire & Cable company	.75	.55	.45	.35	.20

In addition Morse wanted $489.90 for construction, while the Standard Underground and Safety companies included the cost of construction in their bids.

Chief Swenie, when asked about the $500 purchases given above, said: "There used to be a lot of that work, but I have stopped it. There has been none since the first of the year. It is my rule not to allow purchases of more than $500 to be made without a public contract. In case of emergency I go to the comptroller and get his permission to expend the money. When I found out about the practice in the City Telegraph Department I stopped it; and the rule is in force now."

Union Labor After Barrett.

[From the *Chicago Record* of April 13th.]

The Brotherhood of Electrical Mechanics has denounced the business methods of Prof. J. P. Barrett, superintendent of city telegraph, and is making an effort to secure his removal from the city service. As soon as Mayor-elect Harrison is in office he will be asked by representatives of the brotherhood to order a change in the administration of the department over which Prof. Barrett has presided for twenty years and cause to be put in his place of a man who will not favor a few electrical contractors and supply men and will give recognition to union labor. The brotherhood met at its headquarters at 187 Washington street, Saturday, and passed the following resolution:

"WHEREAS, Carter H. Harrison, mayor-elect, has declared himself as being opposed to the favoring of special contractors for city work and supplies, which has worked great injury to the taxpayers; and,

"WHEREAS, The inspection of electrical wiring under the charge and supervision of the present incumbent of the office of superintendent of city telegraph has been conducted in a manner preventing free and open competition, which inures to the benefit of a few favorite contractors and to the detriment of such as have not a so-called "pull," and, moreover, enabling favored contractors to obtain inspection certificates on imperfect and unsafe installations, thereby jeoparding life and property, in evidence of which the recent action of the board of underwriters in employing its own inspectors and refusing longer to recognize the certificates of inspection of the present superintendent of city telegraph, John P. Barrett, is cited; and,

"WHEREAS, There is a growing and widespread dissatisfaction with the superintendent of city telegraph in connection with his purchases of apparatus and supplies for his department, due to the favoring of certain manufacturers, to whom exorbitant prices are paid, to the injury of taxpayers and the scandal of the department; it is hereby

"*Resolved*, That our interests as taxpayers and electrical mechanics demand a change in the present administration of the office of superintendent of city telegraph, to the end that it be conducted in an honest, competent and impartial manner."

The resolution was passed without debate and was an expression of the unanimous sentiment of the brotherhood. A committee will be appointed to present the resolutions to the new mayor and urge his prompt action in putting the city electrical service in such condition that no favors will be shown and the merit system will prevail in fact.

Mayor-elect Harrison has already been conferred with on the question of the removal of Professor Barrett from office, and is giving the matter careful consideration. In addition to the action of the brotherhood, there is a strong sentiment in the electrical trade against the present "boss" of the fire-alarm service.

The exposure of the Barrett methods in the *Record* and the refusal of the Chicago Underwriters' association to accept the certificates of the city electrical inspection bureau, of which Professor Barrett has charge, have already caused changes to be made in one of the concerns which Professor Barrett presented with a large city business, and candidates for the position of head of the fire-alarm service and city electric light plant are openly in the field making a canvass of the electrical trade and profession for support with the coming administration.

Charles B. Quealy, business agent of the Brotherhood of Electrical Mechanics, explained the opposition of the union to Professor Barrett yesterday. He said:

"From the organization of the brotherhood, seven years ago, until now, Professor Barrett has refused to recognize union labor and organization. Not only has he refused to recognize the union, but he has refused to employ union men. During the seven years of our existence he has never employed union labor. We have been to him to get fair treatment and he has never recognized us, except to refuse our requests. All we have wanted is the chance to get employment in the city electrical service when there are vacancies, but we have never had it.

"One strong ground of opposition on which west and is that Professor Barrett has never had a rigid enough system of electrical inspection to cause the employment of skilled workmen on the construction work in the city. There are firms in town who can get work passed by the electrical inspection bureau that I never could get through if I was the contractor. Any sort of work seems to be all right for them, and is accepted by the inspector. This sort of thing is dangerous to the city, as well as injurious to us.

"All that has been done to raise the grade of electrical inspection in Chicago has been accomplished through the efforts of Mr. Merrill, electrical inspector of the National Board of Fire Underwriters. Barrett has had to follow him. Until lately we have been alone in our fight, but now the fire underwriters are convinced that Professor Barrett is not conducting his department in a competent manner.

"Several years ago, during Mayor Harrison's term, some of our union went to him and asked him to put some of us in the electrical service. Mayor Harrison said: 'All right, boys. I'm glad you've come over. We'll fix that up all right.'

"But when he saw Barrett it was different. When Barrett found out we were union men he practically told the mayor that he would run his own department without any help. That is the closest union labor ever came to getting into the city electrical service.

"We never could get a list of the inspection work done under Barrett. Everthing was tight over there. The books of the city were treated as his property, and nobody could get a look at the outside of one.

"We shall urge Mr. Harrison to make a change in the department. Our union has a membership of the best electrical mechanics in the city, and we ought to have a show for the vacancies when they come. Barrett has about 150 good positions that he dispenses, and he fills them without regard for the good of the city service. There are few men working for him that could pass the examinations required for membership in the union.

"Never until now have we felt that our fight was a winning one. But the exposure of Barrett's office, which the *Record* is making and the attitude of the underwriters have stirred the trade up, and we feel that the new mayor will give our resolution careful attention. He has declared himself as opposed to the favoring of contractors for city work, and promised to employ union men where they are competent."

If Mayor Harrison removes Barrett from office he will only be keeping the ante-election pledge made in his speech at Arcade Hall, Englewood, April 2d, which was reported in the daily papers the next day, as follows:

I shall not favor special contractors to the detriment of the taxpayers, as Mayor Swift is doing to-day. If the press of the city would tell what it knows about these contracts and the shameless way in which they are being given away, the knowledge thereof would be nothing less than terrifying and appalling to the citizens of Chicago.

Condition of the Patent Office.

Apropos of the statement in the WESTERN ELECTRICIAN that Mr. Butterworth was peculiarly well equipped to secure reforms in the Patent Office service, the following story, printed by the *New York Tribune* one day last week, is of interest:

"Well, Ben, have you taken official charge of the Patent Office yet?" asked Chairman Cannon of the House Committee on Appropriations of Major Butterworth, to-day. "No, Joe; not yet; but when I do, I am coming down here with enough carriages to bring you and the other members of the committee up there. I want you to see what the condition of affairs is. It is simply shameful to compel men and women to work in such cubby-holes as many of the clerks in that bureau are now forced to occupy." "Oh, we all know about it, and are trying to apply a remedy," replied Chairman Cannon. "Well, I want you to come for all that. Seeing is believing, you know."

At the last meeting of the Cleveland Electric club, E. P. Roberts, the vice-president, presided, and Elmer A. Sperry delivered an address on "The Horseless Carriage." The speaker treated his subject historically and also from a practical point of view. He described the various races run with vehicles of this class in the United States and Europe, and covered the whole subject in an interesting and instructive manner. In the discussion that followed Professor Langley and Messrs. Chase, Dodd, Hoag, Roberts and Sherwood participated.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part III.

Boilers and Accessories.

A complete classification of steam boilers will not be attempted, for the reason that the types which will be found suitable for electric power stations fall under one of four general classes:

1. Fire-tube marine boilers, fired internally.
2. Locomotive type of boilers.
3. Water-tube boilers (horizontal or upright).
4. Fire-tube boilers (horizontal or upright).

Flue boilers, such as the Cornish or Galloway types, coil boilers, as often found in small torpedo boats, plain cylindrical boilers and boilers of the marine and locomotive types will require little of our attention, although used occasionally in electrical plants. The selection, therefore, narrows down, as a rule, to a choice between the "water-tube" and "fire-tube" styles.

In the water-tube boiler the water circulates through metal tubes about and over which the hot gases of combustion freely pass, while in the fire-tube type the heat of the fire passes through suitable tubes running lengthwise of the boiler shell and passing through the water to be heated. It cannot be said that either type of boiler is the better one to be used in every case. That we may be in a position to exercise judgment in the proper selection, it will be well to review the requirements in general of any good boiler.

The first thing desirable is that the boiler should deliver dry steam, and to insure this it should be so designed that there will be provided ample surface for the disengagement of steam, so as to avoid as far as possible that condition of operation known as "priming." The boiler should be capable of maintaining a constant pressure under varying loads. This will require that it have sufficient capacity for the storage of both water and steam and that the circulation of the water shall be free and constant. The boiler should be constructed of the best grade of material and of the best workmanship to insure small expense and maintenance accounts. It is especially desirable to have all the parts accessible for cleaning and repairing, and with this in view one or more manholes should be provided to allow easy access for inspection. The design of the boiler should, as far as possible, prevent any possibility of explosion, and the joints and other connections should be arranged so as to be protected from the action of the fire.

It is important to keep these requirements in mind in selecting a boiler; but, after all, the one important consideration is the one of economy. A boiler designed to provide a heating surface of sufficient extent and properly arranged to extract the greatest possible number of heat units from the products of combustion will give the best evaporation per pound of fuel. Whether this design is of the water-tube or the fire-tube pattern is perhaps more or less of an open question. It is so evidently a case of surrounding circumstances that little reliable information can be obtained. A study of the results of numerous tests upon boilers of different types can only lead to the conclusion that the economy obtained in each particular case was largely influenced by the conditions under which the boiler was worked. If the conditions are good, that particular type shows up well, while under less favorable conditions the same type makes a poorer showing.

To compare the performance of two boilers it is necessary to adopt some proper measure for the expression of efficiency. For a number of years past there has been adopted generally for this measure the "equivalent evaporation from and at 212°" (Fahrenheit) per pound of combustible. This is the evaporation which would be obtained with coal containing no ash, with the feed-water furnished to the boiler at boiling point (or 212° F.) and with the steam delivered at atmospheric pressure of 14.7 pounds per square inch. The "equivalent evaporation" can be obtained from the observed evaporation under actual conditions by the following formula:

$$W^1 = W \times \frac{H+32-t}{966}$$

Where W^1 = the equivalent evaporation per pound of combustible.

t = the observed temperature of feed.

H = the total heat of steam at the observed pressure, as given in the "steam table."

and W = the observed evaporation per pound of combustible.

The following table shows a representative set of results of boiler tests and will serve to compare the performance of the water and fire-tube types.

Kind of Boiler.	Kind of Coal.	Evaporation per pound of combustible.
Water-tube	Pittsburg (bituminous)	11.82
Water-tube	Bituminous	11.63
Fire-tube	Welsh steam	11.52
Fire-tube	Anthracite	11.36
Fire-tube	Summer Hill	11.14
Fire-tube	Cumberland	10.35
Water-tube	Cumberland	9.41
Fire-tube	Mt. Olive (lump)	9.27
Water-tube	Anthracite	9.3
Water-tube	Pittsburg slack	9.13
Fire-tube	Anthracite	8.35

The table shows that economy is, as has already been pointed out, more the result of designing a boiler and its surroundings according to the best proportions to meet a given set of conditions than a question of type alone. With a given boiler, improper setting, the wrong kind of grate for the coal used, insufficient or too much draft, poor firing, etc., may effect the economy to such an extent as to cause a good boiler to make a very poor showing. There seems to be lacking sufficient data to determine definitely the question of which type of boiler is the most efficient, though results at present show slightly in favor of the water-tube type. For small plants, and especially where first expense is to be kept down, the fire-tube boilers have been and will continue to be popular, but recent practice shows that the tendency in all important plants of any considerable size is toward the adoption of the water-tube boilers of any of the well-known makes.

The advantages of the water-tube boiler, which have led to its general adoption over the fire-tube boiler to such a marked event, may be briefly summed up as follows:

First—Greater safety. These boilers are almost absolutely non-explosive—a result due to their design. This allows higher pressures to be carried—a very important consideration when it is the intention to use compound or triple-expansion engines.

Second—They respond more quickly to sudden demands for dry steam. This is a result of large heating surface and powerful circulation of the water in the tubes. They can also be forced to a much greater percentage over their rating than ordinary fire-tube boilers. This is a matter of importance in some stations, where an excessive demand for power is made upon the station only at long intervals, and then for but a short time.

Third—The water-tube boiler occupies less floor space than the fire-tube boiler of the same capacity, and this very often is sufficient in itself to determine the selection.

The disadvantages of the water-tube type of boiler as compared to the fire-tube type are:

First—Its more complicated construction, containing a greater number of joints, which are liable to leak or otherwise get out of order.

Second—Its first cost. Water-tube boilers cost on an average about $15 per horse power set up, as compared to about $12 per horse power for the fire-tube type, thus necessitating an additional investment in boiler plant of fully 25 per cent.

Third—If curved tubes are used, the cleaning will be more difficult, though in most forms of water-tube boilers less surface is accessible for the collection of soot and ashes than in the fire-tube.

The commercial horse power of a boiler is an evaporation of 30 pounds of water per hour from a feed-water temperature of 100 degrees Fahrenheit into steam at 70 pounds gauge pressure. This is known as the "Centennial rating," and is equivalent to 34½ pounds of water evaporated from feed water at a temperature of 212° Fahrenheit into steam at the same temperature. This standard is equal to 33,305 British thermal units per hour. The choice of the size of the units for the boiler plant must necessarily depend upon the choice of the engine, as it is the engine which determines the amount of steam required, and therefore the corresponding number of pounds of water that must be evaporated. The choice of the number of units for any particular plant is governed by much the same considerations as those which influence the size and number of the engine units, and will be taken up at a later time.

Heating Surface.—In preparing specifications for boilers it is usual practice, under the head of "power," to call for 11½ square feet of heating surface per rated horse power for water-tube boilers and for 15 square feet of heating surface per horse power in the horizontal tubular type. The amount of heating surface to be specified may be obtained by first determining the amount of grate area necessary for the combustion of the required amount of fuel to develop the given horse power and then calculating the area of the heating surface by some well established ratio. For instance, it is good practice to allow not less than one-third square foot of grate for each boiler horse power. This assumes a combustion of 12 pounds of coal per square foot of grate area per hour and a consumption of four pounds of coal per boiler horse power, which is the same as an "equivalent evaporation" of 8.6 pounds water per pound of coal—a fair average.

Having determined the grate area, the heating surface can be obtained by multiplying by the ratio 34 5, which figure has been found to be the average value for good economy, with anthracite coal burned under water-tube boilers. This result is the same as allowing 11½ square feet of heating surface per rated horse power. If the boiler is of the fire-tube type or the coal is bituminous, a larger ratio than 34 5 must be used. With anthracite coal in fire-tube boilers the ratio may be taken at 45, which will allow 15 square feet of heating surface per horse power. With bituminous coal the ratio of heating surface to grate area may be taken at 45 to 55, and if the combustion per square foot of grate is intended to be high this ratio may be taken as 60 to 65.

Economy.—Under this head it will not be unreasonable to require an evaporation of 10 pounds of water from and at 212° Fahrenheit per pound of combustible on a test run of 10 hours under working conditions with a fair grade of coal. The coal to be used should always be stated in the specifications, so that a suitable grate of sufficient area can be provided by the boiler contractor.

It is becoming the practice with large boiler plants to receive bids upon the basis of a certain specified efficiency—for instance, 70 per cent.—the contractor to receive a bonus for every one per cent. which is realized over and above the stipulated efficiency. In case the results fail to reach the desired efficiency, a corresponding reduction, which may be the same as or greater than the bonus, is taken from the contractor's price. This practice insures a low price in the bids received, very careful engineering by the boiler contractors, and makes necessary a careful and complete efficiency test upon the plant before acceptance. The amount of the bonus can be determined from the probable annual saving in operating expenses which will result from the evaporation of each additional pound of water per pound of fuel burned. This saving, reduced to a money basis and capitalized, determines the additional investment in the boiler plant which will be justified.

Material.—All shell plates should be of sufficient thickness to withstand the working strain imposed upon them when calculated by the well-known formula

$$P\,d = 2\,t\,f,$$ in which

P = Pressure in pounds per square inch above atmosphere.

d = Diameter of sheet in inches.

t = Thickness of sheet in inches.

f = Safe working limit per square inch of material used, which is ordinarily taken at one-tenth the tensile strength.

In using this formula an efficiency of not more than 60 per cent. of the strength of the shell should be assumed for the joints, and the thickness of the shell correspondingly increased. It is customary to make the end or flue sheets of cylindrical boilers about one-third thicker than the shells, in order to provide sufficient surface against which to expand the tubes. The flue sheets and all other flat surfaces are reinforced by staybolts placed sufficiently close together to prevent exposing too large an area of flat surface to the pressure. The rules for proportioning these bolts and surface may be found in any good text-book on boiler construction. The ends of the cylindrical portion of water-tube boilers are usually made convex, as no flues are attached to them, which obviates the necessity of making them much thicker than the shells or reinforcing them with stays.

Under the head of "material" the specifications should require

First—All shell plates to be made of open hearth fire-box steel, containing about $\frac{3}{10}$ of one per cent. of carbon and having a tensile strength of not less than 60,000 pounds nor more than 65,000 pounds per square inch of section, a ductility of not less than 56 per cent. as indicated by the contraction of area at point of fracture, and an elongation of about 25 per cent. in a length of eight inches.

Second—All beads or flue sheets to be made of the best quality open hearth flange steel, capable of standing the same test as the material required for the shells.

Third—The material of both shells and ends to have the brand, maker's name and tensile strength plainly stamped on each sheet, and so placed that it can be easily seen when the boiler is finished.

Fourth—All longitudinal seams should be of the butt joint type, triple riveted, provided with double covering strips, with the riveting so proportioned that the strength of the joint shall be not less than 70 per cent. of the strength of the shell plates, and the seams so placed as to be well above the fire line. All girth seams may be of the standard lap joint type, and single riveted.

Fifth—All tubes to be of the best lap-welded charcoal iron of standard gauge.

Sixth—Each boiler should be accompanied by a certificate of inspection and an insurance policy for one year of some well established steam boiler insurance company.

Draft.—By means of the draft the air is drawn into the furnace, and by it the gaseous products of combustion are forced through or over the heating surfaces of the boiler. The draft is one of the important accessories to fuel economy. The necessity of supplying the fuel with sufficient air for complete combustion has already been shown. If, on the other hand, too much air is drawn into the furnace, it has been pointed out how the excessive volume of gases will reduce the efficiency. Therefore the supply of just the correct quantity of air is a matter of considerable importance.

There are four ways of producing draft:

First—By means of chimneys, called "natural" draft.

Second—By drawing air into the furnace by means of exhaust fans, called "induced" draft.

Third—By exhausting steam into the chimney.

Fourth—By forcing air by means of blowers through the furnace, called "forced" draft.

The first method of producing a draft by means of a stack is the one usually adopted. The great advantage of this method is its reliability, as there is little about a stack to get out of order. Once built it is ready to do its duty at any time, and it will require but little attention. With a stack of the proper proportions the draft is always ready. The draft with a stack can always be easily regulated by means of a damper up to the capacity of the chimney, and when it is necessary the stack can be forced beyond its normal rating. A stack will carry the obnoxious gases up into the air, where they can be diffused without causing injury to man or vegetation—a consideration which, under some conditions, dictates that this method of producing the draft be adopted.

The disadvantages of stacks are their first cost and the losses which result from their operation. It was shown in the preliminary survey that a large part of the inefficiency of the boiler was traceable to the heat units which were lost "up the chimney." When the stack is "forced" this loss may reach as high as 25 per cent., and never with a fair draft can be below 12 per cent., while the average loss will be between 15 and 18 per cent. With the first method of producing draft this loss will be found to be unavoidable. The draft pressure in a chimney is simply the difference in weight of a column of gas in the chimney and a column of air outside of the same height and area. This draft is usually measured in inches of water pressure. A cubic foot of

water at 62 degrees Fahrenheit weighs 62.32 pounds. One inch of water consequently means a pressure of

$$\frac{62.32}{12},$$

or 5.193 pounds on one square foot. Let us assume as the temperature of the external air 62 degrees Fahrenheit and a temperature of the gases in the stack of 500 degrees Fahrenheit. At these temperatures, the external cold air would weigh .0754 pound per cubic foot, and if the weight of the hot gases be taken at .0427 pound the difference is .0327 pound. For a chimney 100 feet high this difference would cause an upward pressure upon every square foot of cross-section of 100×.0327 pound, or 3.27 pounds. The draft, then, expressed in inches, would become

$$\frac{3.27}{5.193},$$

or .63 inch. The draft is measured with a U-shaped glass tube partly filled with water, one leg connecting by a pipe to the interior of the flue and the other open to the external air. One inch of water is a good draft.

The determination of the proper height and cross section area of a stack is not an exact science. The designer of power stations is called upon often to determine the size of stack which will produce the most economical result with a battery of boilers of a given rated horse power. A rule that is often quoted is that a height of 75 feet is a suitable one for most free-burning coals, 115 feet for slow-burning bituminous, and from 125 to 150 feet for anthracite coals. "Chimneys above 150 feet are costly, and their increased cost is rarely justified by increased efficiency." The determination of the height of the stack is often made either by some such rule or by consideration of the height of surrounding buildings or hills, and then it becomes a question of the proper area.

The given boiler horse power will determine the number of pounds of coal burned per hour. A certain number of pounds of coal is allowed per hour for every boiler horse power, and the problem is to supply a draft which will force that amount of air through the furnace which will result in the best economy.

The value of the draft depends upon three factors, some of which are very hard to determine, others being variable.

The first factor is the temperature of the outside air. This of course is variable; a change from zero to 100 degrees Fahrenheit may reduce the draft fully 50 per cent. This one variable item shows how difficult it is to determine with any degree of definiteness the area of the chimney.

The second factor is the temperature of the flue gases. The temperature usually considered allowable ranges between 400 degrees Farenheit and 550 degrees Fahrenheit. If the temperature is below these values, the draft will probably not be "sharp" enough, while on the other hand if the temperature is allowed to rise above 550 degrees Fahrenheit the draft will be much better, but the increased value will be at the expense of just so many heat units, and will cost too much. It will be shown later how to keep the temperature of the flue gases down below this temperature of 550 degrees Fahrenheit.

The third factor is the constituents of the gases. This affects the capacity of the chimney, as different amounts of air are required to produce complete combustion with different kinds of coal. The weight of the resulting gases will naturally not be the same in every coal. With a certain anthracite coal 12.79 pounds of air will be required (theoretically) per pound of coal, while with a soft bituminous coal the amount of air required is found to be 13.53 pounds. The corresponding weight of gases per pound of coal is 13.74 and 14.43, one being eight per cent. greater than the other.

The fourth factor affecting the value of the draft is the amount of surplus air admitted. The figures just given of 12.79 pounds and 13.53 pounds of air per pound of coal are the amount of air required theoretically to supply sufficient oxygen for complete combustion with two particular samples of coal. It is found in practice, however, that considerable more air than the theoretical amount must be allowed to insure complete combustion, this extra amount frequently reaching as high as 100 per cent. of the theoretical. This surplus air is a "necessary evil" of the chimney draft, and it may act in two ways to reduce the chimney capacity. If the surplus inert air is heated to the temperature necessary for a good draft, 550 degrees Fahrenheit, it will require an extra quantity of coal to produce the heat. With 100 per cent. surplus air this amount of coal becomes fully 12 per cent. of the amount required when no surplus is admitted, resulting in a corresponding loss in economy of 12 per cent. The gaseous products will, it is true, be lighter, and a better draft will therefore be obtained, but the increase in draft from this source is found to be only 1½ per cent., which slight advantage will be more than counterbalanced by the disadvantage of having nearly 96 per cent. greater volume of gases to force through the boiler flues and up the chimney. If, however, the surplus air is not heated to the temperature of 550 degrees, no extra coal will be required, but unfortunately the surplus air will share the heat of the gases of combustion, and the entire chimney temperature will at once become reduced and the draft power correspondingly diminished. This loss with 100 per cent. surplus air is sufficient to reduce the velocity of gases in the stack over 30 per cent., reducing the capacity in the same percentage, while at the same time it becomes necessary to move 96 per cent. more gases than are present with no surplus. Thus it is seen that the most efficient size of stack is obtained only when it provides for a minimum amount of surplus air required for complete combustion, but it is this minimum which is hard to predetermine; consequently the amount of air to be allowed per pound of coal becomes a variable factor, which makes the calculation of the proper size of stack a very unsatisfactory problem.

The fifth factor which affects the draft is the amount of friction which the air and escaping gases encounter in their travel from the boiler front to the chimney top. The friction at the grates will be dependent upon the area of the air passage through them, which will vary from 25 per cent. to 50 per cent., and also it depends upon the construction of the furnace and the character of the fuel. The resistance of the fuel will depend upon its character and the thickness of the bed of fire. Oil and gas will offer little friction. A fine coal will offer more resistance, naturally, than a lumpy one, and a fire burning 20 to 40 pounds of coal per hour per square foot of grate area will require a greater force to draw the air through the furnace than a fire consuming but eight to 15 pounds per square foot. The retarding effect of the heating surface of tubes or flues will vary with the boiler design and type, it always being the intention to retard the gases sufficiently in this part of their travel to allow the greatest possible absorption of heat units. This arrangement of the passages, where two or more boilers discharge their gases into a common flue, will effect the draft, as eddy currents may be set up which will act as a resistance to the flow. The length of the flue leading from the boilers to the chimney will impair the power of the draft to a greater or less extent, depending on its length or cross-section area. If a feed-water heater or economizer is introduced at this point, the loss of draft will, of course, be greater.

Finally, little is known definitely of the actual frictional resistance due to the walls of the chimney itself. These are all vital points which will affect the capacity of the chimney to a considerable degree, and seem to preclude the possibility of obtaining a general formula which will be of practical use. A number of formulas have been attempted, the best known of which are Smith's, Gale's and Kent's. It is not our purpose to enter into a discussion of the relative accuracy of these different formulas. They should all be used with judgment based upon experience. The formula given by Kent,

$$HP=3\ 33\ (A-.6\sqrt{A})\ \sqrt{H},$$

has stood the test of time. A table of sizes of chimneys, based upon this formula, has been prepared, and may be found in Kent's well-known "Mechanical Engineers' Handbook." It has been extensively copied and can be found in most boiler catalogues. The liberal allowance of five pounds of coal per boiler horse power and of only seven pounds of water evaporated per pound of coal has been made in preparing this table. Frequently a much better result than five pounds may be expected, but in such a case the figure in this table may be easily corrected by multiplying the given horse power by the ratio of five to the maximum expected coal consumption per horse power per hour.

In Kent's formula the constant 3.33 is based upon results obtained in actual practice, and is an effort to express the many variables which affect the capacity of the stack. The constant .6 expresses the allowance which is thought desirable for the retarding effect of the ascending gases by friction. This constant has the effect of diminishing the effective area and allows for an inside lining of about two inches of gas, which is considered as having no velocity. A very good rule, which is due to Prof. M. E. Cooley, is handy to remember: "A stack 100 feet high will burn 100 pounds of coal per square foot of area per hour." This rule allows a stack of liberal dimensions for most cases, and if used with good judgment will be found fully as useful in practice as the more theoretical formulas. If it is remembered that the capacity of the stack varies as the square root of the height, it will be easy to apply this thumb-rule to a stack of any dimensions.

[The third lecture, "Boilers and Accessories," will be concluded next week. The remaining portion relates to the construction of stacks and methods of forced draft.]

Ahlm-Edwards Electric Company.

C. E. F. Ahlm, whose portrait is herewith presented, graduated from the Royal Polytechnical College of Stockholm, Sweden, in 1891, and soon after accepted a position with the Wenstrom company. The following year he entered the employment of the old Thomson-Houston Electric company at Lynn, Mass., where he spent considerable time in the factory and in the drafting room. During the year 1893 he went through the expert course of the General Electric company, at the works in Lynn, Mass., and acquired a practical experience in the construction and handling of electrical apparatus. In the fall of that year he accepted an offer to enter the service of the Walker Manufacturing company, then just coming into the manufacture of electrical machinery. He stayed with that company two years, during which time he designed the dynamos and motors which have proved so eminently successful and given the Walker company world-wide reputation. After severing his connection with this company he became associated with the E. & C. Electric company of Cleveland, Ohio, as electrical engineer, and designed a line of small dynamos and motors which in excellence have proved unequaled. In the fall of 1896 Mr. Ahlm and Mr. Edwards formed the Ahlm-Edwards Electric company, which is now manufacturing dynamos and motors up to 1,000 lights or 50 horse power, and the steady increase of the business speaks volumes for the superiority of the machines.

H. J. Edwards.

C. E. F. Ahlm.

AHLM-EDWARDS ELECTRIC COMPANY

H. J. Edwards, who has been well known in the electrical business for several years, graduated in 1891 from the City and Guilds of London Technical College, Finsbury, England, where he had the advantage of studying under Prof Silvanus P. Thompson, the well-known English authority on dynamo-electric machinery. In the fall of the same year he entered the service of the Brush Electric company of Cleveland, Ohio, where he acquired considerable experience in the shop, the drafting room and the engineering department. The company was, just at that time, bringing out its large arc machines, with new automatic regulators, the success of which was largely due to the perseverance and ingenuity of Mr. Edwards. He resigned his position with the Brush Electric company in the spring of 1895 to accept an offer in the engineering department of the Walker company, where he gained considerable experience in the design of multipolar dynamos and motors. In the fall of 1896, when Mr. Edwards entered into partnership with C. E. F. Ahlm and formed the Ahlm-Edwards Electric company, the works were located in Medina, Ohio. On account of the increase in business the works had to be moved to Cleveland, Ohio, and the company was incorporated under the laws of that state. There they are prepared to do business on a larger scale, and will be pleased to receive their customers in their new location.

K. A. K. Covered Third-rail System.

Readers of the WESTERN ELECTRICIAN will recollect that in the issue of September 5, 1896, there was presented an illustrated article on the trolley conduit railway in Springfield, Ohio, that was being operated by O. S. Kelly, a prominent capitalist of that city, in partnership with W. P. Allen of Chicago and A. S. Krotz of Springfield, Ohio, under the firm name of Krotz, Allen & Kelly.

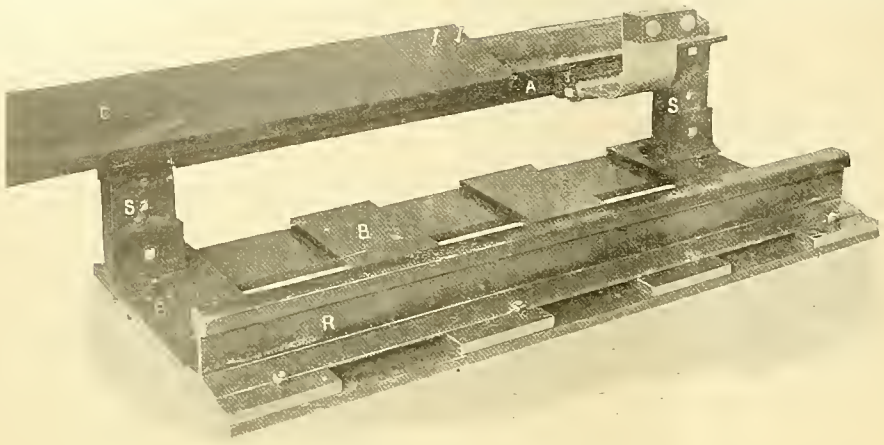
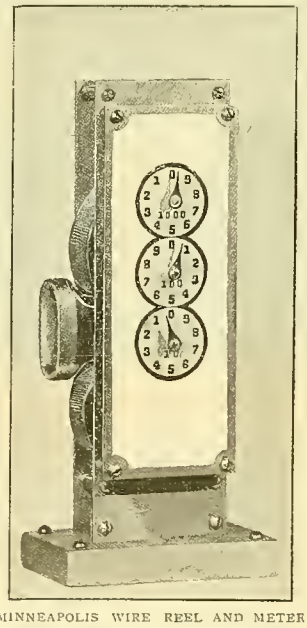


FIG. 1. K. A. K. COVERED THIRD-RAIL SYSTEM.

Since that time the K. A. K. company has been busily at work developing a most important system—the covered third rail, feeling that this is the most practical system of electrical distribution for street, elevated and interurban roads known to-day.

The K. A. K. company recognized, however, at the start that there were two serious difficulties to be overcome in the use of the third rail as applied on elevated roads. For instance, as in Chicago, there is the danger of trackmen and others stepping accidentally on the rails, and also the very serious trouble that arises from the accumulation of sleet upon the rails. As is well known, during the last year or so ice coating on the rails has given these large systems serious trouble, and it is to obviate such difficulties as these that the K. A. K. system was developed.



MINNEAPOLIS WIRE REEL AND METER.

The accompanying cuts illustrate the principal features of the K. A. K. covered third-rail system, having been prepared from photographs of full-sized models now on exhibition in Chicago at the office of W. P. Allen, 1405 Manhattan building. Fig. 1 shows the model of the system for application to steam surface roads, with trolley rail partially uncovered to show details. Fig. 2 shows the construction for elevated roads with the guard rail, or beam, outside of track rail. It should be understood that there is a considerable space between guard rail and standards, which in the illustrations does not appear clearly.

In this construction an angle iron *A*, instead of a T-rail, is used. This is supported on hardwood posts *S*, which have been treated by boiling in oil, and these posts are supported in turn on iron standards on the ends of the ties *B B*, at suitable distances apart. Over the angle-iron trolley rail and partly supported by it is a wooden covering *C*, placed at an angle so as readily to shed the rain and extending far enough over the trolley rail to prevent anyone coming in contact with it. Joining this cover on the under side at the back is another wooden covering extending down behind the posts far enough below the lower edge of the rail to insure the upper part of the post, which carries the rail, being kept thoroughly dry in any kind of weather, and thus making a good and inexpensive insulation. The trolley or contact shoe is supported from the trucks of the car by a flat spring designed, as shown, to travel and be in contact with the two under and inner surfaces of the angle rail, thus securing an excellent contact and where snow and ice can never interfere.

Feeling that the third-rail system is the method bound to come to the front, the K. A. K. company for a long time has been steadily accumulating patents to cover essential details, and with the strong backing the concern is said to have, it should unquestionably be in a position to hold its own in the fight for supremacy among the various systems that will undoubtedly be placed on the market.

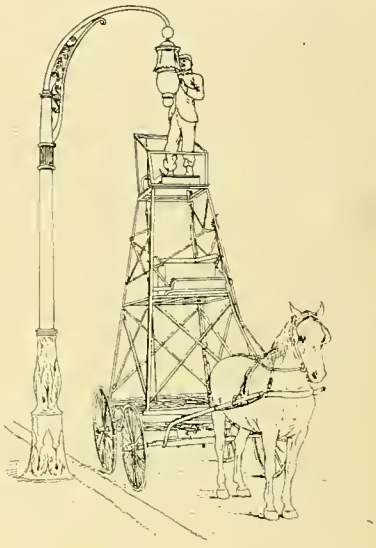
Studebaker Arc Lamp Tower Wagon.

The accompanying cut illustrates the very convenient yet simple form of tower wagon that has recently been placed on the market by the Studebaker Brothers Manufacturing company of South Bend, Ind.

In laying out the new electric lighting system of the West Side parks and boulevards of Chicago, it was found that, owing to the extent of territory covered, the labor of trimming 750 lamps in the usual manner would involve a large annual expenditure. To effect a saving in this department of the operating expense the tower wagon for use in lamp trimming which is herewith illustrated was devised. The result in the short period that the wagons have been used is highly satisfactory; it is found that whereas under the old method of trudging with ladder and kit a workman could clean and trim only about 60 lamps a day, he is now enabled to attend to 250, thus permitting one man with a wagon to do the work of four without.

This wagon is believed to be the first of its kind ever used in the United States. The plan and method of construction are clearly shown in the illustration. An angle-iron tower, provided with wooden platforms, a seat for driving and steps for climbing, is mounted on the spring-supported running gear of a wagon drawn by one horse. The upper platform is surrounded by a railing, to protect the trimmer, who stands here while at work, as shown by the picture on this page. A brake is provided, with a lever handle at this level, so that the wheels may be set on grades and also to avoid the jarring of the wagon by the possible uneasiness of the horse in fly-time. Stiff springs are used to prevent oscillation, which would be magnified, of course, by the height of the structure. The wagon complete weighs about 975 pounds, and it is designed for use in trimming lamps about 19 feet from the ground. One man acts as driver and trimmer with each wagon, and he proceeds rapidly from lamp to lamp on one side of a boulevard or drive, returning on the other side, and not driving in zigzag lines across the street.

In the seat of the wagon is a box capable of containing 2,000 carbons, and a leather bag having space for 200 carbons may be suspended from the top railing, which is also arranged to sustain a bag for pliers and lamp parts and another for sponges, cloths and brushes. A covered bucket of water may be carried on or suspended from the upper platform. The wagon is also found to be useful in hanging lamps to posts, as 15 or 20 can be carried at a time and placed in position quickly and easily.



STUDEBAKER ARC LAMP TOWER WAGON.

One noteworthy feature of the Studebaker wagon is the fact that the tower structure is jointed and provided with a lever, so that in a few seconds the top part can be turned back and down to admit of passage under bridges or similar structures. In this position the wagon will go in a space having a clearance of 11 feet. The illustration presented shows the wagon as ordinarily in use.

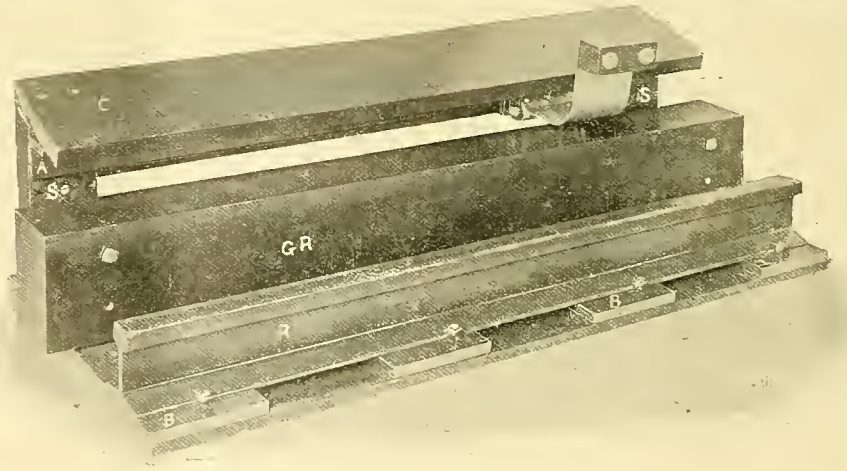


FIG. 2. K. A. K. COVERED THIRD-RAIL SYSTEM.

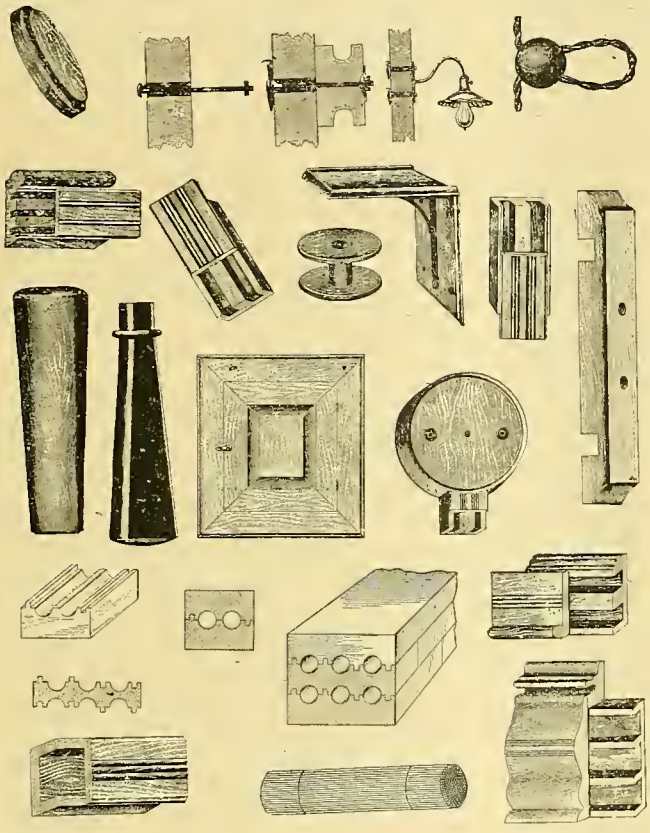
The Chicago City Railway company and the Chicago General Railway company have concluded an agreement by which the latter company will use the tracks of the former on East Twenty-second street and on Morgan and Throop streets for an annual rental of six per cent. of the cost of the tracks.

Electrical Woodwork.

It has been said that nowadays to be successful one must of necessity be a specialist. However this may be, in the line of electrical work there are many who devote themselves to one particular line of business, and it is usually among such specialists that the most successful institutions are found.

For years the C. H. Lever Manufacturing company, Chicago, has devoted its attention to the production of the special woodwork that found a place in the various lines of electrical construction, and to-day this company stands pre-eminent as one of the best posted concerns in this country in the matter of electrical wood moulding and conduit manufacture, as well as a large number of other wooden specialties.

It is said that even during the hard times the company rapidly increased its business, and recently a change of location was found necessary. The factory was therefore moved from 14-16 North Canal street to 19-21 North Jefferson street, Chicago. In the new factory the work will continue to be under the direct supervision of C. H. Lever, and with new machinery and greatly increased facilities the company is in a better



ELECTRICAL WOODWORK.

position than ever to produce the various specialties in woodwork required by the electrical manufacturers.

A glance at the accompanying cuts will give an idea of the variety and the extent to which the Lever company is prepared to respond to the demands of the trade. Without attempting to describe the company's specialties in detail, it may be said that it makes mouldings to comply strictly with the National Board of Underwriters' rules; it is producing electrical recessed moulding specially designed for boat work, and where a perfect insulation is desired with capping that fits down in the moulding making it moisture-proof. Wood room-mouldings are also turned out that are designed specially for running along the walls in place of picture moulding. In fact the company is prepared to produce special moulding of every description in domestic and foreign woods. The company also manufactures wooden rosettes, cleats, switch-handles, and almost any special design of wood turnings; also wood staybolts or boiler plugs, enameled cord adjusters, fan motor brackets and wood cabinets for cut-out boxes. A specialty, too, is made of automatic lathe wood turning, and every description of dowels and poles, and, in addition, the Lever company is prepared to furnish a special white rubber insulating paint for mouldings and appliances where an acceptable finish is desired. The company's sectional wood conduit is also worth careful inspection. By this system every piece if cut into and reversed will make a conduit three-way or six-way as desired, depending on the way in which the moulding is put together.

A valuable specialty that is also manufactured by this company and closely allied to its wooden appliances is the Lever anchor or toggle bolt. A glance at the cuts will show the value of this unique little bolt. These bolts are made of the finest steel, and are guaranteed to stand the greatest strain of any bolt ever offered. As a device for securing moulding, brackets or any fixture to walls or ceilings constructed of fireproof material such as hollow tile, marble, metal, or any place in which a nail or screw is not satisfactory, it has no equal. The bolts are threaded 3½ inches, making any length bolt desired from one inch to six inches long, which saves carrying several lengths to suit different work.

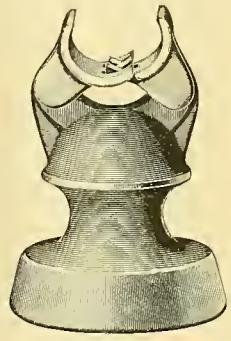
Minneapolis Wire Reel and Meter.

The illustration (p. 222) shows the exterior appearance of the Minneapolis Electric company's new wire-measuring and reeling device. In this meter the wire passes between two self-adjusting rollers, which admit of a wide range, and will measure accurately either large or small wire. The pointers are movable and readily adjusted to the zero point. The meter is also separately mounted on a neat base, to be used on a counter where a reel is not needed. For wire factories and dynamo builders the meter is very useful. A cable meter is made to order only, and is applicable for measuring cables of all sizes, rope or steel cables. Such users as the American Electric Works, American Circular Loom company, Samson Cordage Works, George Cutter, the Partrick & Carter company and S. F. B. Morse commend this measuring reel for wire.

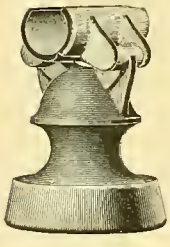
Polarity Indicator and Detector Galvanometer.

The instrument illustrated in the cut is mounted in a neat polished walnut case, small enough to be conveniently carried in the pocket, the usual size being 3½ by 2½ by 1⅜ inches, and the weight 4½ ounces. It is fitted with terminal leads.

This little instrument is designed to indicate the polarity of light and power mains on two and three-wire circuits, also the polarity of dynamos and batteries. It will indicate on circuits from one volt to 700 volts, and a short-circuit cannot be made through it. It will be found very useful in setting arc lamps or motors. The pointer always deflects toward positive terminal. It will be found useful as a pocket detector galvanometer. In workmanship and material employed it is up to the excellent standard of the Keystone Electrical Instrument company of Philadelphia, which is placing this instrument on the market.



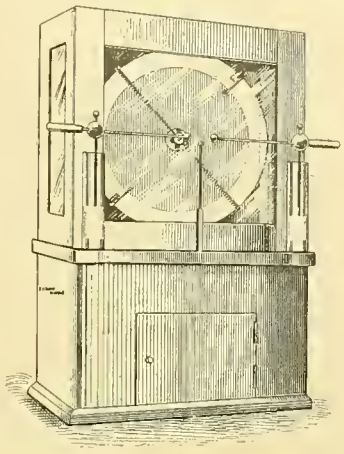
H. W. J. TOGGLE CLAMP FEED-WIRE INSULATOR.



H. W. J. TOGGLE CLAMP FEED-WIRE INSULATOR.

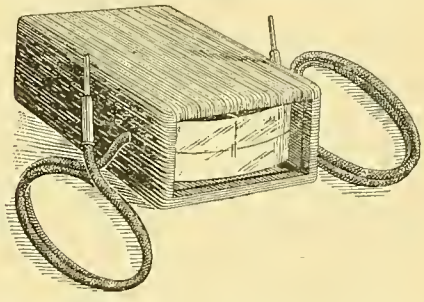
Garlock's Waterproof Hydraulic Packing.

There has been a constant demand for a superior hydraulic packing which would meet all of the requirements of the present day for packing the plungers and pistons of pumps, pumping machinery, hydraulic elevators and hydraulic machinery. Heretofore the best



STATIC OUTFIT FOR X-RAY WORK.

hydraulic packing for these purposes seems to have failed to meet all the requirements. The Garlock waterproof hydraulic packing has been produced from the results of numerous practical experiments and tests on the water ends of pistons and plungers of hydraulic machinery and elevators, pumps and pumping machinery, and the results appear to justify the claim of the manufacturers that they have produced a first-class water-

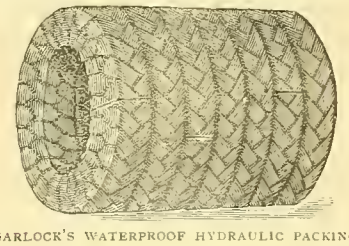


POLARITY INDICATOR AND DETECTOR GALVANOMETER.

proof packing, made of the best quality of selected flax and lubricated with a waterproof compound which is strictly free from acid. These goods are furnished on rod and stuffing-box measurement only, as they must be of an exact fit to give the desired results. The Garlock Packing company, Palmyra, N. Y., is the sole manufacturer.

H. W. J. Toggle Clamp Feed-wire Insulator.

The increasing demand for the larger sizes of feed cables on electric railways has from time to time necessitated improvements in pole insulators with a view of obtaining greater strength, higher insulation and a



GARLOCK'S WATERPROOF HYDRAULIC PACKING.

wider seat for the better protection of the insulating covering. Were it not for the constant contractions, expansions and other movements which cause the wire to shift in its seat, there would be little object in securing the wire to the insulator with the care that is exercised at present.

The kinds of fastenings at present employed may be briefly mentioned as the tie wire, top groove with metal fingers to be hammered over on the wire, and the top groove with screw-cap retainer. All of these methods possess disadvantages, not only for the reason that they do not altogether prevent slipping and wear and tear of the insulating covering, and consume the time of the lineman in attaching the wire to the insulator, but on account of the difficulties in detaching the cable without

loss of time or of damage to insulating covering or insulator. With the view of reducing to a minimum these disadvantages and also to include a feature which would permit of the immediate removal of the wire from the insulator without the necessity of cutting the tie wire, bending back the metal fingers or loosening a screw cap which may have rusted in place, the H. W. J. toggle clamp insulator has been designed. As will be seen from the illustrations, the body of the insulator is in all respects similar to the forms which have become familiar to the users of the feed-wire insulators of the H. W. Johns Manufacturing company. The improvement consists in the addition of jaws for the receipt of the wire, hinged at the sides in such manner as to grasp the wire firmly as they come together with a powerful toggle action. As the weight of the wire causes the jaws to descend, the descending movement has a tendency to force the jaws closer together, and the greater the downward strain the greater will be clamping action. The principle of the toggle has been so nicely applied in the present instance as to form what appears to be a satisfactory, reliable and perfectly automatic clamp for the feed wire. The jaws are three inches long, thus providing an unusually large and desirable resting place for the insulating covering. The action of the clamp is instantaneous. All that is necessary to insert the wire is to open the jaws slightly and drop the wire into place. Although the wire is held in a vise-like grasp, it is readily removed by simply lifting it out of the insulator. The utility of such an instantaneous and automatic form of clamp will be apparent. The feed cable may be strung in accordance with present practice, and may be dropped into the insulators without other cost or effort than that necessary for the lineman to drop the wire into the jaws. If for any reason it becomes necessary to shift or adjust the line, the operation becomes an exceedingly simple and economical one.

Static Outfit for X-ray Work.

The Swett & Lewis company of Boston has an X-ray outfit in which an ordinary static machine is mounted as shown in the cut on page 223, with the motor placed in the bottom of the case. The motor is directly belted to the machine, no gearing or counter-shafting intervening. This arrangement makes the case almost air-tight, and users have been able to operate the machine continually without the disagreeable atmospheric effects noticeable in some cases. A number of these outfits have been sold in the West, and nothing but favorable reports are heard from them.

Texas Gas and Electric Light Association.

The third annual meeting of the Texas Gas and Electric Light association will be held at San Antonio, Texas, April 19th, 20th and 21st. The railroads offer a rate of one and a third fare for the round trip, on the certificate plan. The committee on exhibits has arranged an excellent display of gas and electrical appliances. A number of papers will be read on topics of interest to those engaged in the gas or electric lighting business. The "question box" will be opened and the questions read before the assembly. Each member is expected to ask at least one question and also to assist in answering the questions asked by other members. Many members of the association are using in their plants little schemes and inventions of their own, and the secretary asks that they write short descriptions of them and send them in to the "wrinkle department."

W. E Holmes, chairman of the arrangement committee, writes: "We are preparing a splendid programme for the members and visitors, including a banquet and visits to some of the many points of interest in San Antonio."

Debate on Municipal Ownership.

The third annual joint debate of the Engineers' association against the University of Wisconsin Engineers' club was held at the Law building of the university on April 3d. After a brief address by President Mack and musical selections by Messrs. Stavrum and Seymour the debate was announced. The subject was, "Would it be advisable for the city of Madison, under present conditions, to establish and operate an electric lighting plant for municipal purposes?" P. F. Lueth, H. J. Thorkelson and M. H. Spindler favored the proposition, while T. G. Nee, R. A. Nommensen and John Barr opposed the idea. Profs. Storm Bull, C. I. King and N. O Whitney acted as judges and pronounced in favor of the negative. The exercises were closed with musical selections by Messrs. Freschl and Logeman. The debate was exceedingly interesting and instructive throughout. The committee in charge consisted of C. W. Hart, H. C. Schneider, I. S. McNichol, E. Schildauer, F. J. Newman and R. D. Jenne.

An Electric Railway Under Interstate Commerce Regulations.

The Interstate Commerce Commission holds, in the case of Charles M. Wilson against the Rock Creek Railway company of the District of Columbia, that the railway company named, operating a line of electric railway lying partly in the District of Columbia and partly in the state of Maryland, is subject to the provisions of the Act to Regulate Commerce, although it appears to be constructed upon or along public highways, and is essentially a street surface road for the conveyance of urban and suburban passengers. This, of course, gives the commission jurisdiction of certain questions as to rates, and it was on this account that the questions in dispute were brought before the commission. The railway company and a land company owning land and a suburban hotel along the line of railway, although distinct corporations, were under substantially the same ownership and control. The land company purchased passenger tickets of the railway company at full rates of fare, and sold them at half rates to guests of its hotel, to persons residing upon land which it had sold or otherwise transferred, and to others, but refused to sell such tickets at half rates to persons who, though living in the same locality, resided upon ground not acquired from the land company. Upon the evidence presented, the commission holds that no discrimination was practised by the railway company; that the community of interest between the two corporations resulting from common ownership was not made a device for enabling the railway company to evade its legal obligations; and that the action of the land company in discriminating between persons in the sale of tickets for the benefit of its separate business was not subject to correction by the commission. Two commissioners dissented on each proposition.

Electric Railway Companies Must Pay for Use of Country Roads.

Judge Johnson of Milwaukee handed down a decision on April 7th in the South Milwaukee crossing war between the Chicago & Northwestern road and Milwaukee Electric Railway company. The decision is of especial importance to steam railroads, it being the first to bring before a court the question of the use of country roads for electric railways.

The court says in effect that electric companies cannot make use of such a road as a right of way, where it is the intention to carry anything except passengers, without paying damages to the abutting property-holders. This applies to cities as well as to the towns and villages. The steam railroad companies all over the country have been viewing with considerable apprehension the advance of the electric lines, which have made great inroads on their revenues by competing for suburban traffic.

While the steam railroad companies have been obliged to condemn and pay handsomely for their right of way, the electric railway companies have been making use of the public highways without paying for them.

BOOK TABLE.

WIRING TABLES: HOW THEY ARE MADE AND HOW TO USE THEM. By Thos. G. Grier. Chicago: 1897. Price, $1.

A new book with the above title has been recently issued by the author. It is a logical and clear treatment of the wiring table. The writer considers first the resistance of wires, following with a discussion on electromotive force and current strength. The development of a simple formula upon which all the wiring tables are figured is clearly shown. The method of calculating and compiling tables is given, with the application of the tables to the various methods of wiring and diagrams for series, multiple arc, multiple series, series multiple and Edison three-wire systems. Ohm's law is clearly defined, and throughout the book technical expressions are avoided as much as possible and where used are explained. The book has 76 pages, 27 commercial wiring tables, and is bound in cloth. It is of much practical value.

The attempt of several stockholders of the Harrison International Telephone company to secure a receiver for the corporation has failed, as Judge Grosscup handed down a decision against the complainants. The court based its refusal to interfere on a rule of the court, which requires stockholders who claim fraudulent conduct on the part of a corporation to first seek redress through the official board of the corporation. This was not done in the case of the complainants.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 10.—Nikola Tesla was the attraction at the Academy of Scieoce last Tuesday evening, when he explained several of his discoveries and intimated the direction of the experiments upon which he is now engaged. Mr. Tesla exhibited a new electrical oscillator, based upon a discovery made by him six years ago. Mr. Tesla announced that the manufacture of ozone and other chemical products now attained by costly processes may be done economically and cheaply by the vibrations produced by this apparatus. He said it furnished an ideal instrumeot for the production of the Röntgen rays. Its advent means the abolition of many devices of older design, particularly, Mr. Tesla said, of the use of the induction coil. Upon the subject of the Röntgen rays, Mr. Tesla announced that he had made two important discoveries. The first is a powerful source in an electric arc under certain conditions. The second is the deflection of the rays by a magnet, the fact needed to establish the identity of the Röntgen ray and the ray discovered by Lenard in 1891. Mr. Tesla said that in 1894 he himself was investigating the actinic action of phosphorescent bodies and observed the Röntgen rays, but did not recognize them. He said that ever since Röntgen's announcement of his discovery scientists have been endeavoring to establish the identity between the Röntgen and Lenard rays by deflecting them by a magoet. The deflection, however, was so slight that the finest instruments could not record it. Mr. Tesla tried for a long time and failed. At last he invented an instrument by the aid of which, he said, a boy could perform the experiment. Mr. Tesla showed diagrams and designs tending to prove his theory that Röntgen rays were formed by streams of minute electrified particles of matter projected from the bulb at an extreme velocity.

Members of the New York Electrical society had an opportunity on April 7th to listen to an informal talk by E. E. Higgins upon the "Financial Practice and Engineering Methods of American Street Railways," which he delivered at Columbia College.

There is the usual trouble for telephone companies at Albany this year. At the hearing of the Brush telephone bill before the Senate committee on cities on April 8th, U. N. Bethell, the general manager of the New York Telephone company, pointed out that the bill was identical with the measure that had failed of passage on previous occasions, and that its only supporters were the knot of professional agitators who periodically appear at Albany with the same arguments, notwithstanding the changes that have been made in rates by the telephone companies. The arguments in favor of the bill, he said, were based chiefly on fictitious figures said to be contained in the Ainsworth report, which Mr. Bethell showed by extensive quotations from the report itself to be absolutely without foundation. The advocates of the bill, in speaking of New York city, had always referred to the flat rate of $240, as if that were the only rate available to telephone users. As a matter of fact, Mr. Bethell said, telephone service was supplied today to many subscribers in New York at rates of $75 and $90 a year each. The $240 rate was now adhered to by only the very large users, wealthy firms and corporations. There were about 1,800 of these large users, just 10 per cent. of the total stations in the system. On the other hand, the rate of the large majority of the subscribers would be raised were the bill to become a law, as there are 10,700 subscribers taking service under the message-rate system, whose average rate was under $109. The rate fixed by the bill was $125.

Commissioner of Public Works Collis decided to grant a permit to the Metropolitan Traction company to tear up the streets necessary to change the motive power of the Eighth avenue surface road from horses to electricity. The application for a permit to tear up Sixth avenue is still under consideration, but as it asks for practically the same thing as the Eighth avenue line General Collis will probably act favorably upon it. A number of representatives of the City club and the Knights of Labor protested against the granting of these permits on the ground that a change of motive power might interfere with the right of the city to acquire these roads under the provisions of their charters, which provide that they must file a statement of the cost of each mile with the comptroller, and that the city may at any time have the privilege of buying the lines for their actual cost plus 10 per cent. The corporation counsel,

however, has held that a change from horses to electricity would not prejudice the rights of the city. He also stated that there was no statute in existence under which the city could issue the bonds necessary for the purchase of the roads. Mayor Strong, to whom numerous protests have been made against allowing the motive power of these lines to be changed, will discuss the matter this afternoon with some of the representatives of the Knights of Labor.

The Electric Carriage & Wagon company now has six motor cabs licensed. The number is to be steadily increased. Each cab has two motors of 1½ horse power each. An average speed of eight miles an hour is promised, but 15 miles an hour can be attained if necessary. It is said the vehicles are much less expensive to operate than ordinary cabs.

Word has come from Albany that a bill in the interest of the "Huckleberry" trolley line has been passed quietly through the Assembly, giving authority "to extend, widen and change the grade of West 135th street." The real object of the bill is to give authority to run a trolley line through St. Nicholas Park and to change the grade of the street for the benefit of the trolley company. Mr. Wilds, the deputy commissioner of public works, recently said that the alterations authorized by the bill would compel the Department of Public Works to reconstruct sewers and relay water-mains at an enormous cost to the city. B. J.

PERSONAL.

H. J. Medbery, president of the Fiberite company of Mechanicville, N. Y., and H. B. Coho of New York were in Chicago during the early part of the week.

William Willshire Riley, who died at Middletown, Conn., last week, is said to have been an electrical inventor of considerable local fame. He acquired distinction as a poet, then devoted several years to dentistry, after which he went on the stage. He claimed to have invented an electric railway system.

Francis M. Ireland, formerly associated with F. W. Parker, has opened an office as a patent lawyer at 62 Merchants building, Chicago. For some years Mr. Ireland was engaged in the electrical business, and he afterward practiced law for a couple of years before joining forces with Mr. Parker, the well-known patent attorney. Mr. Ireland will make a specialty of electrical patent work, for which his experience and acquaintance well qualify him.

The list of out-of-town visitors registered at the headquarters of the National Electric Light association for the week ended Friday, April 9th, included D. Urquhart, Fremont, Ohio; George W. Vallee, Philadelphia, Pa.; P. J. Bennett, Syracuse, N. Y.; C. E. Newton, Hartford, Conn.; A. P. Seymour, Syracuse, N. Y.; W. C. Bryant, Bridgeport, Conn.; C. E. Scott, Bristol, Pa.; A. D. Page, Harrison, N. J.; F. S. Terry, Chicago, Ill.; C. H. Rockwell, Cleveland, Ohio; J. C. Felton and H. C. Wirt, Schenectady, N. Y.; C. E. Bibber, H. Brooks and J. Wilson, Boston.

ELECTRIC LIGHTING.

An important contract for an isolated lighting plant was recently awarded by "The Fair" department store in Chicago. The managers of this large establishment are building an eight-story addition to the concern to make the State street frontage uniform with that on Dearborn street and to present a continuous front on Adams street. A large electric light plant, mainly composed of Standard arc machines, is now operated in the basement of this store, but, with the completion of the new building, the installation is to be entirely remodeled, and three 100 kilowatt direct-connected units will be added for incandescent circuits. After keen competition among the electrical manufacturers, the order for the dynamos was secured by the Westinghouse Electric & Manufacturing company, which was represented by Frederick Nelson of the Chicago office. The new machines are wound for 125 volts and will be driven by Ideal side-crank engines. They will have a combined capacity for 4,800 incandescent lamps of 16 candle power each, although much of the current will be used for constant-potential arcs. When the remodeled plant is complete it will contain nearly 1,000 horse power in electrical machinery.

ELECTRIC RAILWAYS.

The commission which has charge of the laying out of the Great Shore driveway in Brooklyn, has made a satisfactory arrangement with the Brooklyn Heights and the Nassau Electric Railroad companies by which the trolley tracks will be kept clear of the driveway. President Rossiter of the Heights company has agreed to take $42,000 for the property owned by the company at Fort Hamilton and remove the tracks, and the Nassau company has also agreed to surrender its franchise to cross the driveway for $7,500.

The officers of the Cicero & Proviso Street Railway company of Chicago have offered to put on the "owl" cars again and bury the feeder cables from the Northwestern crossing at Pine street to Waller avenue, a half-mile away. But the trustees of the town of Cicero desire greater concessions, and want the cables put underground from end to end of the line. They went even further and startled President Cummings by asking for a five-cent fare to the center of the city. He protested that it was impossible, but with the opening of the electric service of the Northern Pacific over the tracks of the Lake street structure the trustees think that a nickel will pay for a ride from Austin town hall to the Auditorium.

Representatives of the Baltimore & Ohio Railroad company and the Staten Island Electric Railroad company, who are equal partners in the ownership of the Rapid Transit Ferry company, held an election for directors at the Ferry house at St. George, Staten Island, April 6th. The agreement which was effected last week, by which it is expected that the troubles between the partners will be settled, was carried out by the election of the following-named directors of the ferry company: John K. Cowen, Thomas M. King of the Baltimore & Ohio Railroad company, J. Frank Emmons and Albert B. Boardman of the Rapid Transit Railroad company, Henry H. Rogers, Gen. Samuel Thomas, Thomas F. Ryan and Col. G. B. M. Harvey of the Staten Island Electric company, and W. L. Bull, who is said to have been named by Mr. Cowen. The directors did not elect officers, but the agreement provides that Colonel Harvey shall be chosen treasurer of the ferry company, thus giving the electric company representation in the executive management of the company.

TELEPHONE.

The work of constructing the large building of the New York & New Jersey Telephone company in Brooklyn, at Willoughby and Bridge streets, is under way.

The Citizens' Telephone company has been granted a charter to establish a telephone exchange, set poles and run lines in the city of Franklin, N. H. Work will be begun as soon as the ground opens. Laconia already has an exchange by the Citizens' Telephone company which is working satisfactorily. A line will be run to Franklin via Tilton. Franklin has an exchange now owned by the New England Telephone company. As that company has had very little competition in New Hampshire and as the Citizens' Telephone company's work is claimed to be satisfactory and less expensive, no little interest is manifested in the new extension.

The newspapers print a dispatch from Toledo, O., detailing an unusual form of robbery in that city. The Central Union Telephone company has pay stations over the city, where collections for long-distance service are made automatically. Each of these machines gathers considerable money in the course of a week. Just before the last hour of collection thieves went through the boxes, tore off the hasps and carried away the contents. One of the stations is in the American District Telegraph office, within a few feet of all-night operators. The lock was twisted off and the drawer pried open with a jimmy. The station box in the Produce Exchange was treated in the same manner. At the Boody House, the leading hotel of the city, the outside padlock was broken off. At the Burnett House the cash box was pried open after the lock had been twisted with a pair of pliers. How the work could have been done under the noses of many people, in the most public places about the city is a mystery to the police department, which has been unable to secure the slightest clew. How much the robbers secured cannot be estimated. Steel cash-drawers will hereafter be used by the telephone people. This is believed to be the first robbery of the kind on record.

MISCELLANEOUS.

The Electrical Workers' association of Chicago has been organized for social and beneficial purposes. Electrical workers in all branches are invited to join. Information will be furnished by the secretary, George Gilmore, of 239 Illinois street. The other officers are T. J. Hara, president, and W. W. White, vice-president.

The statement of the General Electric company, as filed with the commissioners of corporations of Massachusetts, March 1st, shows: Assets—Buildings, $444,437; cash and debts receivable, $10,176,755; manufactured and merchandise, $3,988,757; patent rights, $8,000,000; debentures in treasury, $512,132; miscellaneous, $11,787,682; profit and loss deficit, $12,697,685; total assets, $47,607,448 Liabilities—Capital stock, $34,712,000; debts and reserve, $12,895,448; total, $47,607,448.

TRADE NEWS.

Direct current dynamos and motors are made by the Central Electric & Foundry company of Lewisburg, Pa. Bipolar, multipolar and iron-clad machines are manufactured and a catalogue giving useful information is sent on request.

R. B. Corey of New York, one of the best known electrical men in the country, has taken charge of the sale of the Columbia incandescent lamp in the eastern territory, in addition to his other lines of electrical goods. Mr. Corey will be pleased to see his friends at his office, 1103 Havemeyer building. Oscar Hoppe is associated with him.

The Electric Appliance company reports that it is rapidly closing agency arrangements in different parts of the country for its 1897 line of fan motors and ceiling fans. It is offering a full line of direct and alternating fan motors, and also a full line of direct and alternating current ceiling fans, and is prepared to offer attractive arrangements to good live agents.

The property of the J. H. McEwen Manufacturing company, Ridgway, Pa., has been sold to the Ridgway Dynamo & Engine company. Mr. McEwen retires from the business and a number of heavy capitalists of Western Pennsylvania have gone in to the new company. William Sharp is the Chicago agent of the new company, which proposes to make an active bid for business.

James L. Robertson & Sons, successors to the Hine & Robertson company of 68 Cortlandt street, New York, give notice of removal on May 1st to 204 Fulton street, at which place their facilities will be much larger, enabling them to carry a more complete line of packings, steam specialties and supplies for immediate delivery. A catalogue illustrating devices of interest to every steam user will be cheerfully sent to anyone on receipt of request.

Some time since an engineer in a large factory called the attention of a visiting electrician to the electricity from a big driving belt, and was quite surprised when the expert stated that the electricity was caused by the belt slipping. The expert added that it was simply a waste of power and could be prevented by applying Dixon's traction belt dressing, made by the Joseph Dixon Crucible company, Jersey City, N. J. This dressing was applied, and the electricity is said to have disappeared at once.

The electrical trade in general, and particularly the telephone people, will be interested to know that F. J. Kusel, who has for so long been president of the Missouri Telephone Manufacturing company of St. Louis, and who in fact mainly built up that company's extensive business, has sold out his interest in that institution to his associates and others who will continue the business in St. Louis. It will be interesting to know that in the course of three years, starting in the basement with one man, Mr. Kusel has built up an institution that he has good reason to be proud of. As to his plans for the future, these are as yet undecided. It is a question whether he will form a connection with one of the large existing telephone companies or whether he will organize a new company to carry on the manufacture of telephonic apparatus.

An X-ray outfit which has just been placed upon the market by the Fessenden Manufacturing company of Pittsburg, Pa., operating under the patents of Prof. Reginald A. Fessenden, is said to be of great simplicity, both in design and operation. The induction coil is built perpendicularly and the resistance and condenser are so arranged that no adjustment of those appurtenances is necessary. The projecting-rod on top of the machine is used as a starting device, it being only necessary to throw in the switch, push a starting-rod, and the machine at once starts up without any further attention or adjustment. The speed is regulated by an adjustable brush-holder device. All of the starting and regulating devices are so grouped that the operator may manipulate the same with one hand, while at the same time holding the fluoroscope and taking views.

What appears to be a practical and useful book has been issued by the Elbridge (N. Y.) Electrical Manufacturing company, under the title "Pointers on Electric Lighting for the Inexperienced." The little book (76 pages and 41 illustrations) is not written as an advertisement, but is designed to assist practical business men and others who are installing small electric plants and who wish to be told briefly how they should be installed and managed, and how to use the instruments which have been placed on their switchboards. Simple directions are given in clear language; the underwriters' requirements are explained, and useful books for reference are recommended. It is not advisable, of course, for a layman to attempt to install a plant of any considerable size without the advice of an electrician or engineer; but in very small isolated plants the directions of this book, carefully followed, may serve as a substitute for expert supervision, especially in localities where the personal oversight of a competent electrical man can be had only at considerable expense.

BUSINESS.

The products of the Detroit Electric Heating company include flat-irons, stoves for heating and devices for cooking. The address of the company is 132 Shelby street, Detroit, Mich., and an inquiry will bring a circular or other desired information.

The Metropolitan Electric company is sending out a comprehensive catalogue covering electrical and combination fixtures, which it manufactures. This catalogue is complete in every detail, and a great many of the fixtures are now shown to the public for the first time.

The New York office of the Keystone Electrical Instrument company has been removed to the Smith building, 15 Cortlandt street, where the company occupies a fine suite of rooms. The increase of business in and around New York made it necessary for the Keystone company to seek quarters better adapted to its growing business. Elmer P. Morris will continue to be the representative in the district mentioned.

J. B. McKeague, western manager for the Imperial Porcelain works, formerly at 369 Wabash avenue, is now located in more commodious quarters at 324 Dearborn street, Chicago. Mr. McKeague is doing a good business in Wirt dynamo brushes, for which he is Chicago agent. He also handles Queen-Wirt portable

ammeters and voltmeters, of which he has sold quite a number within the last few weeks.

The full line of aluminum reflectors which the Central Electric company is carrying in stock is meeting with a ready sale. These reflectors are considerably lighter than the old-style reflectors, with the same radiating effect, and they possess certain points of superiority which the trade will find worthy of investigation.

The electrical trade will be interested to learn that George M. Pullman, Jr., has become associated with the Metropolitan Electric company, Chicago. Mr. Pullman has been with the Pullman company about four years, and, while retaining an active interest in it and its affairs, will devote himself most energetically to the business interests of the Metropolitan company.

The illustrated catalogue and price-list of the Garvin Machine company of New York shows a fine line of machine tools, including universal and plain milling machines, screw machines, drill presses, hand lathes, cutter grinders, gear cutters, forming machines, tapping machines, profilers, etc. The business was established in 1862, and is now widely extended. The offices, salesrooms and factory are located at Spring and Varick streets, New York.

The Stromberg-Carlson Telephone Manufacturing company recently installed a very handsome switchboard at Michigan City, Ind. The Stromberg company, under the new arrangement, is pushing ahead in a manner that would indicate that the new blood recently infused in the concern came from a fighting ancestry. General Manager Ross is out for business, and from the fact that it has been the aim of the Stromberg company ever since its inception to produce apparatus entirely free from infringement of any kind, the company is gaining friends every day.

The Bergmann '97 Bijou long-life enclosed arc lamps are made by the General Incandescent Arc Light company of 572-578 First avenue, New York, which issues an attractive pamphlet to show their advantages. This lamp is made for 50 and 100 hours of burning with one pair of carbons, and operates with a potential of about 80 volts across the arc. It is provided with a resistance mounted on the lamp, so that it can be connected in multiple on circuits of 100 to 120 volts, provision being made in the resistance for this range of variation in the pressure. The regular amperages for which the lamps are built are three and five.

General Superintendent and Manager J. J. Nate of the Standard Telephone & Electric company of Madison, Wis., is feeling well satisfied with the company's business. It recently secured a fine 200 drop exchange in Indiana, and the Standard company also recently reported that it had closed exchanges in Texas, Iowa, Wyoming and Wisconsin, all of which speaks well for the new general manager, who has just taken hold of the business. Mr. Nate certainly ought to make a success of the telephone business, as he is one of the most experienced men in it, and his knowledge of telephonic details extends back to the earliest days of the art.

The Warren Electric Manufacturing company, although hardly installed in its new and extensive plant in Sandusky, Ohio, is kept busy filling orders. A 30 kilowatt Warren alternator goes to New Castle, Ont., and a 45 kilowatt machine to River De Loup, Quebec. This last-named machine was sold through the Ontario Electric & Engineering company, Toronto, Ont. A 60 kilowatt Warren alternator was also sold through Thomas & Hunter, agents at Charleston, S. C., to go to Wilson, N. C. Taking all in all, the Warren company is meeting with every encouragement, and will undoubtedly have to rush matters to keep up with orders.

The H. W. Johns Manufacturing company, after occupying for 25 years the old building, No. 87 Maiden Lane, New York, will move around the corner on May 1st into the ground floor offices in the new Woodbridge building, No. 100 William street. This removal makes of especial interest the statement that a recent examination of the company's orders shows that over one milllon pieces of vulcabestom have been sold to manufacturers of dynamos, motors, street car controllers, arc lamps, etc. The sale of the moulded mica trolley line insulating materials has also greatly increased. The company extends a cordial invitation to its friends to visit it in its new quarters.

The Orne Electric Construction company of Chicago has just issued its third telephone catalogue. The book is handsomely illustrated, showing the many different styles of instruments and other electrical goods which this company manufactures exclusively. Several pages are devoted to diagrams and instructions, showing how to wire and connect up in the simplest and most practical way the different systems of telephones. At the end of the book are a few fac-simile letters from some of the largest concerns in this country, who recommend the telephones described in this book. The catalogue will be sent free to any address within the Postal Union. The offices of the company are in the Owings building.

The bicycle electric light is attracting much attention, especially at this season. To obtain a light that will not jolt out has been the aim of lantern makers since the advent of cycling. To jolt and depolarize the primary battery has been the aim of electricians. With a perfect jolter like the bicycle the primary battery is claimed to work well, and the aim of the electrician is accomplished. One of the hardest workers in this branch of electrical science is Albert C. Fletcher of Cleveland, Ohio, the inventor of the necktie light, pocket battery, etc. Those who have worked in this line will appreciate what has been accomplished. How bicycle riders appreciate the "Ohio" bicycle electric light can be realized by those who have attempted to keep lighted an ordinary lantern on their wheels. All who are interested can obtain illustrated circulars by addressing the Ohio Electric Works, Cleveland, Ohio, which manufactures this and many other electrical novelties.

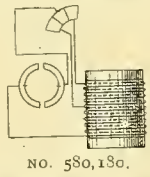
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued April 6, 1897.

579,975. Magneto-electric Generator. Webster Gillette, New York, N. Y. Application filed July 31, 1895.

The shunting device consists of a sleeve of insulating material surrounding a shaft and attached to a sleeve of conducting material, having a flange at one end, both of such sleeves having an elongated slot in the same admitting a carrying-pin inserted in the shaft, on which the insulating sleeve operates, with a spring attached to the conducting sleeve to act as a recoil to the conducting and insulating sleeves, such sleeves being operated by a handle or other device, and such shunting device being attached to or in combination with a shaft driving a train of gear-wheels.

580,011. Armature Core. Sidney H. Short, Cleveland, Ohio. Application filed January 19, 1897.



NO. 580,180.

An armature core is built up of laminæ, and has spacers interposed between the laminæ and separated therefrom.

580,035. Art of and Apparatus for Generating and Distributing Music Electrically. Thaddeus Cahill, New York, N. Y. Application filed February 4, 1896.

The method of producing composite musical sounds electrically consists in producing by induction in different closed circuits electric current undulations corresponding to different component sounds of the composite musical sound desired, synthesizing in a conductor resultant undulations out of the undulations produced in a plurality of closed circuits, and translating the built-up electrical undulations into composite aerial vibrations of similar wave form.

580,057. Electric Railway System. William Robinson, Boston, Mass. Application filed January 21, 1895.

A traveling trolley or contact-maker is provided with a differentiating device constructed and arranged to actuate or control the magnet or magnets of the primary or controlling circuits by differentiating the currents passing through the coils of the magnet without actually opening the circuits or making a dead short-circuit of the same.

580,092. Electric Push Button. Robert L. Moore, Statesville, N. C. Application filed June 30, 1896.

Contact devices are carried by a cap, and fasteners comprising pieces of wire are bent into eyes and secured to the cap, the fasteners being adapted to receive securing devices.

580,114. Electric Brush Holder. Theodore J. Loughridge, Oshkosh, Wis. Application filed June 1, 1896.

An angle-finder is provided with an open face, and is pivotally connected to the holder; separated rollers are journaled in the angle-finder, and have their peripheries lying in the same plane, and means are provided for locking the angle-finder in adjusted position.

580,166. Telephone Circuit. John S. Stone, Boston, Mass. Application filed June 26, 1895.

A local talking circuit at a sub-station containing an electrolytic cell, a telephone transmitter, and the primary of an induction coil grounded between the electrolytic cell and the transmitter are combined with a main telephone line, one end of which is connected with the common source of current, and the other with the secondary of the induction coil, and also with the local talking circuit at a point between the primary of the induction coil and the electrolytic cell.

580,180. Magneto and Dynamo-electric Generator. Charles H. Wade, James Moores and Henry O. Farrell, Manchester, England. Application filed January 5, 1897. Patented in England October 27, 1896, and October 30, 1896.

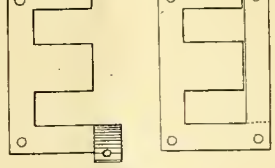
In magneto and dynamo-electric generators an armature coil is divided into two or more sections; there is a series of terminals to which the ends of each section are connected, and which rotate with the armature; a contact is adapted to slide over the successive terminals with variations of speed, and there are spring-controlled pin-rubbers for taking off the current.

580,206. Electrical Transformer Plate. Richard W. Blackmoore, Peoria, Ill. Application filed November 20, 1896.

An electrical transformer plate is described, having two openings for receiving a given coil of the transformer, and provided with two cuts, one communicating from one hole to the outside edge of the plate, and the other communicating from one hole to the other hole, and both cuts lying in a rectilinear line, which coincides with an edge of each hole.

580,244. Apparatus for Manufacturing Ozone. Charles J. Yarnold, London, England. Application filed August 20, 1896.

In an ozone generator there is the combination with the casing of the series of plates, each consisting of a layer of conducting material held between sheets of non-conducting material disposed side by side in vertical planes parallel with the direction in which the oxygen-bearing fluid passes, and having the non-conducting sheets ribbed or corrugated in a direction transverse to the direction of the flow of the fluid, the electric terminals, and connection between the terminals and the layers of conducting materials.



NO. 580,206.

580,246. Conduit System for Electric Railways. Arthur O. Babendreier, Washington, D. C. Application filed October 26, 1896.

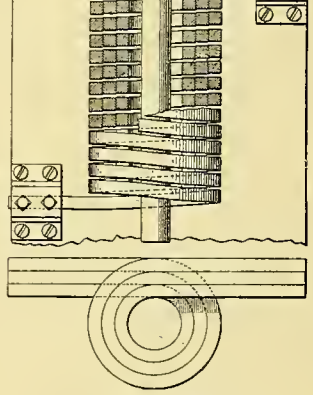
An insulator support is provided, comprising a casing provided with outwardly projecting lugs at each end thereof, brackets fixedly secured to the lugs, and means for supporting the brackets within the conduit.

580,256. Electric Arc Lamp. William J. Davy, London, England. Application filed December 9, 1895.

One feature is a cut-out for an arc-lamp, consisting of a contact-piece adapted to make contact with a second contact-piece to short-circuit the lamp and its own operating mechanism when the arc becomes abnormally long, and a latch-lever carrying a third contact-piece, adapted when the lamp has been short-circuited to fall under and make contact with the first contact-piece to continue the short-circuiting until a current is again established through the lamp.

580,276. Electro-magnetic Coil. Walter E. Harrington, Philadelphia, Pa. Application filed January 15, 1896.

An electro-magnetic coil having radially deep and axially narrow composite windings, which are made up of two or more separate bars connected in multiple, and the outer ones being coiled on those next within to form the composite windings as specified.



NO. 580,276.

580,277. Magnetic Circuit Breaker. Walter E. Harrington, Philadelphia, Pa. Application filed January 15, 1896.

In an electric circuit a switch lever is adapted to close and open the circuit; a counterbalance is rigidly attached to the lever, and so constructed and arranged as to tend when the switch is closed to hold it closed and when the switch is opened to carry it away from the circuit terminals; there is an electro-magnet, the coils of which are in series with a switch, and an armature not normally in contact with the switch-lever is actuated by the magnet, and adapted to move under a predetermined current arranged to impinge against the switch-lever and force it in a direction to open the circuit.

580,320. Electrical Cut-out. Herbert C. Jones, New York, N. Y. Application filed August 12, 1896.

Claim is made for the combination of a suitable exterior casing provided with a longitudinal passage, recesses in its under side and a pendent wall, spring contacting points in the recesses and between the pendent wall and the outer wall of the casing, a cut-out plug having contacting points at its lower end and a stop to limit its rotary movement, and adapted to be slipped into the longitudinal passage of the casing and turned to bring the contacting points together.

580,339. Electrical Circuit Closer. Oliver F. Allen, Springfield, Mass. Application filed December 18, 1896.

In this device there are the two electrodes normally out of contact, either or both coated with easily fusible conductive metal, in combination with a receptacle adapted to hold the molten fusible metal in contact with both electrodes.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, APRIL 24, 1897. No. 17

Construction of Chicago Edison Company's Underground Conduit in Jackson Street.

Advancement in underground construction work for the distribution of current from central stations for light and power has kept pace with the development of other branches of the art, and experience acquired in this department has led to the introduction of many improvements and changes that have materially raised the standard of the service.

Probably the best example of modern methods that can be found in this country to-day is the work now being done by the Chicago Edison company on Jackson street, which embodies every advancement known to the art. It is the purpose of the company to put down in this thoroughfare a permanent conduit system, in which provision is made for all possible extensions and enlargement of the service in the district supplied from these mains. The necessity for developing a permanent system was brought about by the decision of the city to boulevard Jackson street. All corporations having property underground in that thoroughfare were notified that the roadway would be repaved with asphalt and that mains and feeders for gas, electric lighting, telephones and telegraphs should be remodeled and rearranged for permanent use so that the street would not have to be reopened to repair their systems of distribution. Before beginning the work of reconstruction the engineering department of the Chicago Edison company, under the direction of L. A. Ferguson, made a careful investigation of the needs of the district to be supplied, and then proceeded to develop a system that would meet the most exacting requirements. Many new features were designed especially for this work, and it is claimed by the experts of the company that the installation embodies every improvement and refinement that will enhance the value of the service.

During the last four weeks the company has been actively engaged in the construction work on this line, and the complications that have been met and overcome have attracted much attention among engineers. The scene of operations is in the heart of the down-town business district, where it is, of course, necessary that the work shall be done expeditiously. For this reason arc lamps were strung along the street at short intervals to enable the workmen to prosecute their labors by night as well as during the day. The picture on this page, Fig. 1, gives an excellent idea of the methods employed. It is a general view, looking east from the Board of Trade. Those familiar with the locality will realize the necessity of pushing the work vigorously. The diagram, Fig. 2, shows the extent of the work. In this installation there are included 19 junction-box manholes, located at street intersections, 30 service distribution-box manholes between street intersections, and 31 small manholes on north-and-south ordinary drawing-in cable systems, without any of their disadvantages.

FIG. 1. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—GENERAL VIEW.

At each street intersection two large manholes, averaging 10 feet square, are built of brick, with steel-beam and arched roof and heavy iron cover of special design for asphalt pavement. An excellent view of one of these manholes in course of construction in front of the Board of Trade is shown in Fig. 4. The main duct system enters these manholes from the east and west, and ducts branch out, running north and south across Jackson street to small manholes located on intersecting thoroughfares immediately north and south of Jackson street. The north and south ducts are to be used for feeders and mains crossing Jackson street and joining the Jackson street mains through the junction boxes, which are located in the large manholes at the street intersections. The six-way Tailleur junction boxes, each having a capacity of 2,000 amperes at 250 volts, provided with copper safety catches for disconnecting the feeders and mains in case of trouble, are placed in the large manholes at the street intersections. This junction box is shown in Fig. 5, and a 10-way box, also used in the system, is shown in Fig. 6. These junction boxes are bolted to the side walls of the manhole, and into them run the feeders connecting with the mains. The cables are soldered to the terminals, which in turn are bolted to hard rubber blocks. Between the terminals and the main bus-bar are placed the copper catches to make connection, as in the ordinary Edison junction box. In the cut (Fig. 5) some of these are shown open while in others the connection is made. Each junction box is arranged to provide for one feeder and four mains, each pair of junction boxes being connected by a tie-line cable in the main duct system, thus using all of the terminals of the box. Within each junction box there are incandescent lamps, controlled by an automatic switch so connected that when the door is opened the lamps light up immediately, providing light for the underground men. These lamps are also used for testing purposes. Upon closing the door of the box, the lamps are cut out automatically. The manholes in which these junction boxes are placed are trapped to the sewer, so that all the water which comes in through the ventilated iron manhole cover is drained off to the sewer. A back-water trap is provided, which prevents sewage from backing up into the manhole. The iron cover is pro-

streets which cross the main line on Jackson street. It will be seen from the drawing that the company is laying a complete conduit system the entire length of Jackson street, from Michigan avenue to the Chicago river, the number of ducts varying from nine to 18, according to location. The Edison tube mains, with their services, as well as the Edison tube feeders, are being taken up and replaced with lead-covered cables drawn into cement-lined ducts (Fig. 3), manufactured by the National Conduit Manufacturing company of New York. The present series arc and 500 volt power circuits will be drawn out of the old Dorset and pump-log ducts and drawn into the newly laid cement-lined ducts. The new duct system provides a method of distribution combining all the advantages of the Edison tube system and the

vided with twelve 15-inch slots, so that any stray gas which enters the ducts may pass out of the manhole through the ventilated cover, thus preventing pocketing of the gas, which has caused so many explosions. With this arrangement of sewer connection and ventilation no explosions have occurred, and this seems to be the only practical solution of this vexed question.

The entire conduit line enters the junction-box manholes and the cables are neatly trained around the walls, those not entering the Tailleur junction box passing around the walls of the manhole and out through the ducts. In the subsidiary manholes on the main duct line, only the upper tier of ducts terminates at the walls the lower tiers passing through the manhole and forming the foundation for the service distribution box.

On the main conduit system at intervals of about 70 feet are built smaller manholes four feet square, called subsidiary manholes, in which are placed the service distribution boxes shown in Fig. 7. From these manholes three three-inch iron pipes extend north and south across the street, so that service cables may be drawn in ducts from the subsidiary manholes to the buildings which are to be supplied with electricity. These service distribution boxes are designed to carry a load of 1,400 amperes—700 amperes on a side—this being the full load of the Jackson street low-tension main. The box itself is of cast-iron, provided with a bolted cover and molded rubber gasket, so as to keep out all moisture. The electrical conducting parts of the box are made of a special cast copper, known as M. B. metal, having a conductivity of 84 per cent. There are no safety fuses in this service box, the cable main and cable services

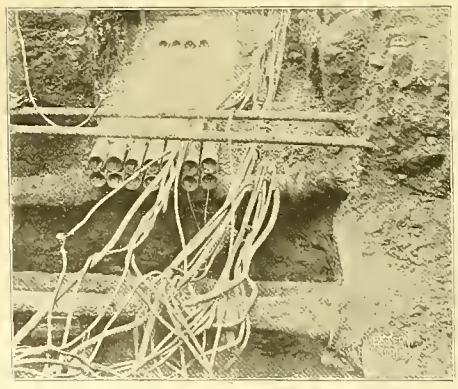


FIG 3. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—DUCTS IN TRENCH.

being soldered to terminals, which are bolted to the three flat bars of the service box. With this arrangement it will be an exceedingly simple task to locate faults, and repairs can be made without delay or inconvenience to consumers, as the length of cable between the service manholes may be drawn out without putting any customer out of service. Moreover, it will not be necessary to tear up the street to remove trouble, as is the case with the ordinary Edison tube system.

The cables used in this work are paper insulated, lead covered, juted and asphalted over the lead, and are 500,000 circular mils per main and No. 000 B & S. for services. The arc circuits are No. 6 B. & S. paper insulated and lead covered cable, and for pressure wires for feeders a special three-conductor paper insulated cable, leaded and asphalted, is used. The cables were made by the National Cable company of New York from the specification of the Chicago Edison company.

The junction boxes, service distribution boxes and all details of the conduit system, excepting the duct, were designed by the electrical engineering department of the Chicago Edison company and manufactured in the company's machine shop. George Tailleur, the superintendent of the underground department, who originated the junction box which bears his name, has charge of the construction of the Jackson street installation. The installation contains many original features for which credit is due to Mr. Ferguson, whose careful attention to details is manifest throughout the entire work. Altogether it is a splendid example of engineering work and illustrates the remarkable advancement that has been made in this line in this country.

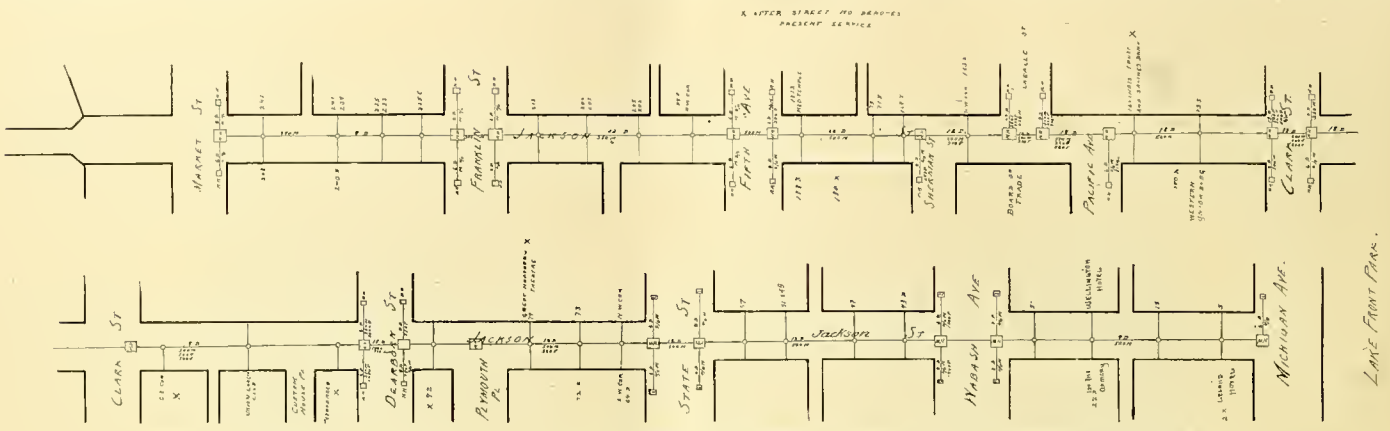


FIG. 2. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—GENERAL PLAN OF WORK.

Death of J. J. Storrow.

James J. Storrow of Boston, the famous patent attorney, dropped dead in the Congressional Library at Washington on April 15th. By general consent Mr. Storrow was regarded as the foremost figure at the patent bar of the United States, and by many he was considered as the best patent lawyer that this country has produced. He was the leading counsel of the American Bell Telephone company, and for the last 15 years he had devoted the greater part of his time to the affairs of that great corporation. So valuable were his services as the company's legal adviser and advocate in its intricate patent relations, that he has been described as "the man that made the Bell company." Certainly no patent monopoly was ever more skillfully maintained and defended. The assaults were—and are, for that matter—vigorous and persistent, directed by many able minds, but until the expiration of the receiver patent by time limitation the patent policy of the Bell company, directed by Mr. Storrow, stood as an impregnable rock against all opposition. In the Bell-Drawbaugh litigation Mr. Storrow particularly distinguished himself by his masterly presentation of his client's case before the Supreme Court, and he received a high personal compliment from Mr. Justice Harlan. Mr. Storrow was also widely known for his attainments in international law. He took an important part in the proceedings incident to the arbitration treaty between the governments of Great Britain and Venezuela for the settlement of the boundary line dispute. He was appointed special counsel by the Venezuelan government to represent it, and his brief was considered one of the clearest and best presentations on the boundary question that was prepared. After Minister Andrade and Sir Julian Pauncefote had agreed on the terms of a treaty, Mr. Storrow accompanied the former to Venezuela when the treaty was presented to the president of that country. He returned to the United States with Mr. Andrade and since then spent most of his time in Washington. He was 60 years of age.

Prof. Forbes to Examine the Nile Cataracts.

Prof. George Forbes is both ubiquitous and indefatigable, according to the estimate of the London *Electrician*. The last time he was heard of by the civilized world he was busy investigating the electrical potentialities of the Zambesi Falls. Now, if the daily papers are correct, the Council of Egyptian Ministers has approved of the appointment of Prof. Forbes to examine the Nile cataracts and prepare an exhaustive report regarding the best methods of electrically utilizing the available power. Prof. Forbes is to commence his investigations in the autumn.

Industrial Education.[1]

By R. H. Thurston.

The encroachment of German trade upon the markets of Great Britain is one of the most striking and important events of our time, and, though less exciting, is probably a more important matter than the action of Germany or of Great Britain in the affairs of Crete. Even a serious contest in Europe, like that occurring in the Crimea 40 years and more ago, or between France and Germany 25 years since, only means the loss of a few thousand lives and the extinction of a few hundred or of a thousand or two millions of dollars' worth of property; while the peaceful conquest by Germany of the British, the French, the American market, either or all of which may be thus affected, would mean the increase of the wealth of Germany in larger amount than by the receipt of the French indemnity fund, and would not improbably result in loss and poverty on the other side, giving rise to more suffering and unhappiness and mortality even than would a great war.

Just how much of this conquest, already begun and so far accomplished as seriously to alarm the statesmen of Great Britain, is due to the wisdom and foresight of Germany in organizing her wonderfully extensive and complete system of state education and of schools of applied sciences and of the trades and professions of constructive arts no one can, of course, definitely say; but there is no question that this statecraft, put in operation generations ago and consistently and steadily adhered to for decades and up to our own time, is very largely the basis of the remarkable trade development which is today attracting the attention of intelligent men and of all statesmen throughout the world. A famous and statesmanlike engineer and ship-builder, John Scott Russell, the builder of the Great Eastern and the author of the now familiar "wave-line theory" of ship construction and of various published works, including one on "Systematic Technical Education," was in Germany

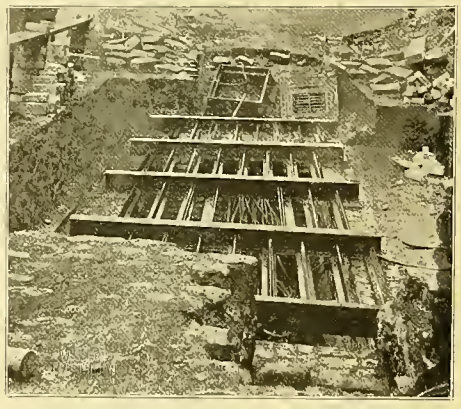


FIG. 4. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—MANHOLE IN FRONT OF BOARD OF TRADE.

about a half-century ago and in 1869 wrote of his observations thus:

"Twenty years ago professional duty took me to Germany for the first time. I cannot forget my first impression at the sight of whole nations growing up in the full enjoyment of systematic, organized, I might almost say perfect, education. I had already become acquainted with some theories and forms of education. I had read Plato's description of the perfect training for a nation. I was familiar with education in England, Scotland, and in France. I was familiar with elementary schoolteaching, and enjoyed the privileges of university education and the still higher education of the workshop. I was familiar with the system of Bell and Lancaster, having had personal acquaintance with its authors, and had myself taken an active part in schools of art and mechanics' institutions; but I confess to have been profoundly astonished—I may say humiliated—at the sight of

1. Communication to *New York Tribune*.

nations whose rulers had chosen to undertake the systematic education of their people, and of peoples who had chosen to bear the burdens and to make the sacrifices necessary to obtain it. I do not know to what men or class of men in Germany the forethought, organization and patriotism are to be attributed which made them lay aside personal ambition, political animosity, religious sectarianism and state parsimony in order to unite all classes of the people in a unanimous effort to raise every rank in society to a higher condition of personal excellence and usefulness, and, by diffusing equality of education, to extinguish the most grievous of class distinctions."—("Systematic Technical Education." London, 1869. See also

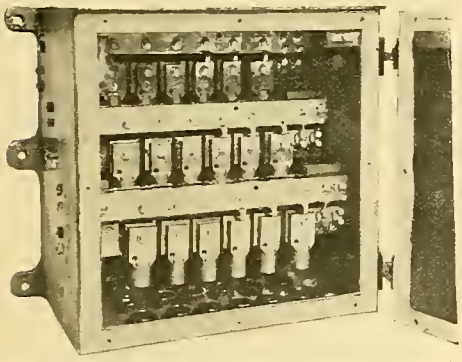


FIG 5. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—SIX-WAY TAILLEUR JUNCTION BOX.

Report of N. J. State Commission, 1878, and "Technical Education" in the U. S., Trans. A. S. M. E., 1893.)

This great governmental system of technical education is as universal in extension as it is national in character, and every German city has its manual training and trade schools, and every province its polytechnicum and its scientific side in the university. In Germany, even more than ever in France, the governing and the educated classes are promoting in all possible ways this education of the people to do the work of the nation. All work for a common end. Prussia has spent, it is said, not less than $4,000,000 on its great technical school at Charlottenburg; Zurich $500,000 on its new laboratory alone at its polytechnicum, and Saxony—half the size of Vermont—spends an equal sum annually on its state university. Some slight idea may be formed of the extent and importance of this movement in Germany when it is stated, as the writer has sometimes put it, that to educate our people as well as the most favored parts of Europe, as Germany, we should have in this country:

"Twenty technical universities, having in their schools of engineering and higher technics 50 instructors and 500 pupils each.

"Fifty trade schools and colleges of 20 instructors and 300 students each.

"Two thousand technical high schools, or manual-training schools, of 10 instructors and 200 pupils each.

"That is to say, there should be in the United States to-day 1,000 university professors and instructors and 10,000 students under their tuition studying the highest branches of technical work; there should be 1,000 college professors and 15,000 pupils in technical schools, studying for superior positions in the arts; and 20,000 teachers engaged in trade and manual-training schools, instructing pupils, 400,000 in number, proposing to become skilled workmen. We have in this country 10,000,000 families, among which are at least 1,000,000 boys who should be in the latter class of schools. The cost of such education would be, per annum, about 50 cents per inhabitant additional to the present school tax, and in the shops of these schools less than $100 per student, and for total costs of higher education under $300 per annum per student. Such is the work of which so small a part, at most, can be done by existing colleges, however great the desire of the authorities to carry out the intentions of the people. Such is the somewhat intimidating comparison, also, of the condition of our country, and the more enterprising and wisely governed countries of Europe. The latter have had generations the start of us, and only extraordinary natural advantages of our country, and the more extraordinary general intelligence and enterprise of its citizens can possibly prevent this disadvantage under which we labor from telling fatally against us in the course of time, when the inevitable competition of the world shall affect us."—("Technical Education in the United States." See also Reports to the Trustees of Cornell University by the Director of Sibley College, 1894.)

Obviously, the only safe and sure way of meeting such competition is to secure, by a similar or more effective system, through statecraft and well planned political movements, an equally fruitful system in our own country. This was, indeed, begun a generation ago, in the very height of the excitement of our Civil War, by Senator Morrill and his colleagues, and the so called Morrill bill, organizing the "land-grant colleges," was the first step in our country toward the introduction of that statesmanlike policy of encouragement and support of industrial education and education in applied science which has since been our mainstay in the organization of a tardy public school and college system in the United States, in which incorporation of the technical methods of France and Germany, with, in some respects and in some places, real improvement upon foreign methods, has been the distinguishing feature. Our system has, however, lacked persistency, consistency and complete extension. It is in the hands of the several states, and in some has proved liable to inefficiency through ignorance on the part of the non-technical and unprofessional men who have been intrusted with the control of technical schools or schools of engineering, or through culpable misappropriation of funds intended to be employed in the establishment of "industrial education," or through lack of interest in the great questions which have come to be more serious and more vital than, if possible, even those of peace and war. Below and behind all this inefficiency lies, of course, much indifference respecting the future of our country, or a blind and childish and misleading confidence—precisely such as has also been displayed, to her sorrow, by Great Britain—that no foreign nation can disturb the markets or the peace of mind of the people of the United States. England to-day suffers, and now our state legislatures—mainly, however, those of the western states—are becoming interested in the work and promoting it magnificently, as a matter both of common prudence and sensible politics and as a matter of state pride. The state universities of the country, between the Ohio, at least, and the Pacific, are leading in this regeneration of the modern state. They are coming to be "people's universities."

Such are needed. They are those which Dr. Schurman has described:

"A people's university, if it is true to the spirit of the age, must hold all subjects equally reputable, and provide instruction in all alike. Least of all can it afford to omit those industrial arts which lie at the foundation of our modern life. But, with them, it must include every interest of the people which admits of scientific treatment. The masses and the classes must both be represented. Or, rather, such a university can recognize no such distinction; for the objects of every occupation must be esteemed equally significant. The analysis of soils is as important as the analysis of literature. The steam engine is as sacred as Greek. Philosophy is not more venerable than roadmaking. A

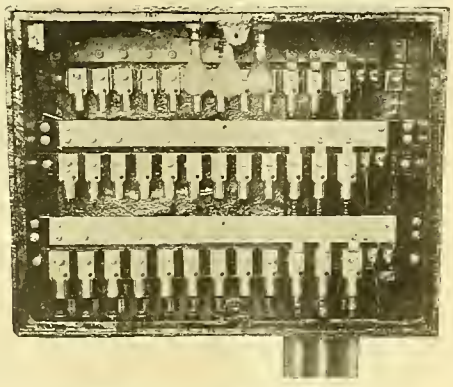


FIG. 6. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET.—TEN-WAY TAILLEUR JUNCTION BOX.

house is as rational as the geometry that it embodies. We must no longer dream that the little section of knowledge that we cultivate is the holy of holies. Every atom of the universe is equally worthy of regard.

> All are but parts of one stupendous whole.
> Whose body nature is, and God the soul.

* * * "In God's universe there is nothing common or unclean, and whatever is known about it must have a place in the curriculum of a people's university.

"As the same able writer and eloquent speaker has asserted, the curriculum must be as varied as are the wants of the people. The day of the people has arrived, and, 'if since the foundation of Salerno, universities have been dedicated to the investigation of nature with a view to providing a remedy for human diseases, they now assuredly need a fuller consecration to the same service for the additional purpose of rendering more available to our helpless race those natural powers and operations by which the works of man are affected and the life of man sustained.'"

New York, like all the states in the older section of the country, except, perhaps, Massachusetts, has been very tardy in this work; but the great middle West and the state of California are doing a magnificent work, usually setting aside a specific tax, as a constant and permanent support for their state universities, and giving them each year more and more of that aid and sympathy which are essential both to their steady advancement and highest efficiency. Our own state, the "Empire State," is now hesitatingly taking up this work, and we may hope in time to see technical education and the industrial arts placed upon a safe and productive basis. Should we fail, Germany will yet affect our industries precisely as she has those of Great Britain, for we must henceforth look to exportation in disposal of our manufactured surplus if we would keep all honest men steadily employed at living wages and thus avoid that congestion which gives rise to epidemics of unrest, demagoguery and dangerous strife.

It should be noted, however, that Germany has of late years been experiencing the outcome of another great political movement and industrial policy. Great Britain for decades sustained a protective system, and, aided by the inventive and constructive genius of her people, her Watts, her Stephensons, her Arkwrights and her numberless other great engineers and mechanics, built up her enormous manufactures and foreign commerce. After she had become mistress of the world of industry and could safely do so, she adopted that free-trade policy, in 1846, which was unquestionably best for a nation dependent upon manufactures for a living, incapable of supplying her own agricultural products in sufficient quantity to meet the needs of her people, and in all ways ready to go out into the whole world vending her wares.

The policy proved successful. But at about the same time Germany began the study of the same problem in its (to her) different aspect. Germany came to the same policy finally that had been at the beginning adopted by Great Britain, and she systematically encouraged and stimulated her own domestic manufactures. To-day she is at the doors of Great Britain with her wares, and is underselling the "mistress of the seas" in every part of the world, sending abroad her products, and her people as well—for her trades-union systems include provision for sending out unemployed and ambitious citizens of Germany to foreign countries for mutual advantage. For Germany, protection proved wise, while for Great Britain, at the same time, free trade was equally wise.

The people and the legislators and the statesmen of the United States may well profit by this lesson. With a "complete and perfect education," as Milton called it when urging it on his country more than two centuries ago, providing all that "the people's university" and its attached industrial and common school system should give, and with wise and moderate and systematically—perhaps automatically—adjusted protective legislation, sustaining and encouraging those industries which give a people steady work and good returns for their labor, and which may encourage and diversify the whole industrial system of the country, there should be no good reason for fear that our country will ever suffer in competition—in a wholesome and stimulating competition—with the rest of the world. The conjunction of the plans of Senator Morrill and his colleagues of 1862 with those of intelligent and wise promoters of a diversified system of manufactures will give us ultimately eminence—we will hope and believe pre-eminence—among the most enlightened nations of the world. But it is for the legislatures of the states, even more than for that of the United States, to do what is to be done. The responsibility lies largely, if not mainly, on them. It is they who are to educate the generations which are, in turn, to build up a nation.

Alley "L" Improvements.

Marcellus Hopkins, receiver of the Alley "L," the Chicago railroad about to abandon steam locomotives for electric power, has filed his final report in Judge Haney's court and asked to be discharged. The document covers the entire period of the receivership from October 5, 1895, to April 5, 1897, and gives in detail all receipts and disbursements. The average daily traffic for the term was 37,627 and the total net earnings $331,111, being at the rate of $683 a day. On this basis the annual net earnings appear to be approximately $250,000, or nearly 2½ per cent. on the present amount of capital stock. The receiver transferred the road to the South Side Elevated Railroad company February 1st, but the receivership has continued. The last business has finally been completed, and, according to the order of the court, Mr. Hopkins has turned over $180,000 to Master in Chancery Perry A. Hull, which will cover the payment due the boodholders who did not assent to the plan of reorganization. Preparations are now being

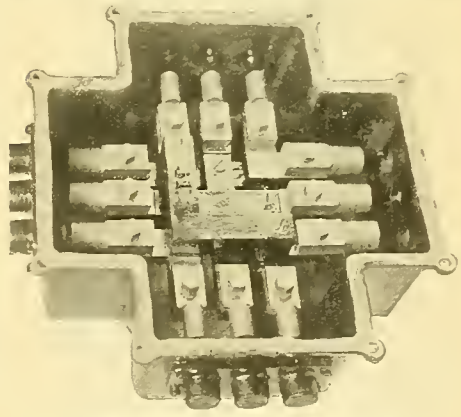


FIG. 7. CONSTRUCTION OF CHICAGO EDISON COMPANY'S UNDERGROUND CONDUIT IN JACKSON STREET — SERVICE DISTRIBUTION BOX.

made to hasten the building of the link connecting the road with the Union Loop. The directors will soon decide definitely upon the plan to be followed in financing the improvements and new structure. It is proposed to execute a mortgage covering the road and authorizing the issue of $1,500,000 of bonds. Of this sum only $700,000 will be needed immediately, as the new company has $300,000 in cash, and it is estimated that the extensions and improvements will not cost over $1,000,000. The contract for building the electric power house at Fortieth and State streets will probably be let this month.

The Sioux City Electrical Supply company has filed two chattel mortgages at Sioux City, Ia., one to E. M. Beach, trustee, covering all supplies and furniture, and a bill of sale to the same person of the book accounts. The First National Bank has filed a chattel mortgage, subject to the prior mortgage, for $4,877.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part III.—*Continued.*

Boilers and Accessories.

Construction of Stacks.—Chimneys are constructed usually either of brick, iron or steel. The construction of a typical brick stack may be seen in Figs. 7 and 8, which show a chimney 150 feet high. For the first 30 feet from the top the thickness is eight inches; for the next stage of 30 feet the thickness is 12 inches, and corresponding increase in thickness of one-half brick occurs at each of the next two stages. The batter of the outside shell is one-fourth inch per foot. Half way up the inside extends a brick core, which is perfectly independent of the outside stack. This construction is

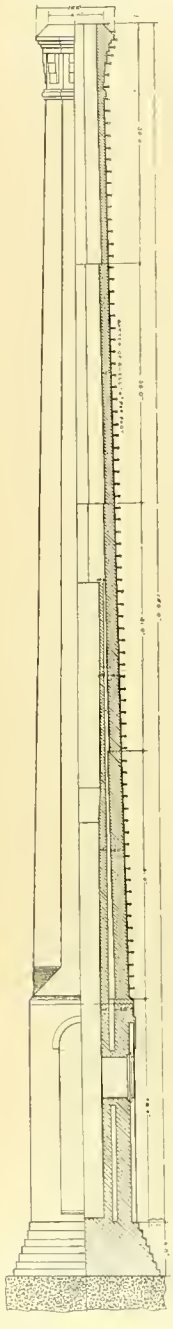

FIG. 7. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS. — TYPICAL BRICK STACK (ELEVATION AND VERTICAL SECTION).

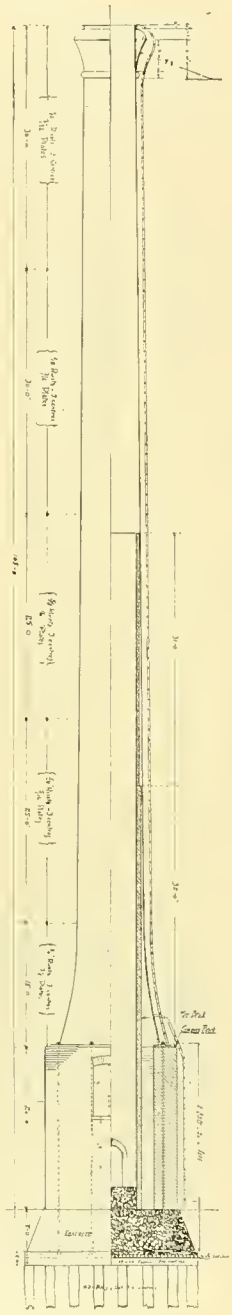

FIG. 9. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS. — TYPICAL STEEL STACK (ELEVATION AND VERTICAL SECTION).

adopted to avoid strains due to the unequal expansion of the two shells. The air space between the core and stack proper also acts as a non-conductor of heat and thus prevents radiation. The top of the chimney is capped with an ornamental top, and the entire structure rests upon a bed of concrete. The load on the foundation should not exceed two tons per square foot in compact sand, gravel or loam, though it may be much greater on rock bottom. Foundations are to be discussed at greater length in a future lecture.

In calculating for wind pressure allow 50 pounds per square inch for a plane surface directly facing the wind, or 27½ pounds per square foot of the plane projection of a cylindrical surface. In making calculations for the stability of brick stacks a principle stated first by Rankine is often quoted: "It has been ascertained by observation of the success and failure of actual chimneys, and especially of those which respectively stood and fell during violent storms, that in order that a round brick chimney may be sufficiently stable its weight should be such that a pressure of wind of 27½ pounds per square foot of plane projection shall not cause the resultant pressure at any bad joint to deviate from the axis of the chimney by more than one quarter of the outside diameter at that joint." With this rule the stability of the chimney to resist wind pressure is due entirely to the weight of the chimney and the diameter of its base. The cohesion of the mortar and the strength of the inner core are not considered. This rule may be worked out graphically for any portion of the chimney by laying off downward from the center of gravity of the corresponding cross-section the weight of the portion considered. From the same point and with the same scale the total wind pressure on the section is drawn at right angles to the line representing the weight. The resultant, as determined by combining the two forces, should not deviate from the axis of the stack at the base of the portion considered by more than one-fourth the diameter at that place. This rule is certainly a safe one.

Steel Chimneys are being used more and more, as their advantages become better appreciated. As a rule, for medium sized capacities, they will be found cheaper by 30 per cent. as compared with brick chimneys; they can be erected much quicker, will take less space, and will be found much stronger and safer, and more economical, as their use avoids the infiltration of air, which is a common cause of the checking of the draft in brick chimneys. The construction of a typical steel chimney is shown in Figs. 9 and 10. This stack is 145 feet high and is built up of plates varying from a thickness of $\frac{3}{8}$ inch at the top to a thickness of three-eighth inch at the bottom. In this case the stack was lined but half-way up with a core of fire brick, but with large steel chimneys the brick lining often extends the entire height of the chimney, the lower half being made of second quality fire brick and the upper half of hard burned red brick. The method of flaring the chimney at the bottom and making the stack self-supporting, by securing the cast-iron base to the brick foundation by means of heavy bolts, is shown in the drawings. With this construction no guys are necessary. The foundation for the chimney consists of concrete, upon which is built a sub-structure of brickwork.

In figuring the chimney to withstand the stresses due to weight and wind pressure, it may be considered as a hollow cylindrical beam, fixed at one end and loaded uniformly. The wind pressure may be taken the same as in brick chimneys.[1]

Induced Draft was given as the second method of producing draft. It is fair to say that this method represents most modern practice. In this method a stack is erected just high enough to rise far enough above the roof of the power house, so that the gases will not be objectionable, and the draft is produced by means of fans or blowers placed at the bottom of the stack or in the leading flues. This method overcomes a great many of the disadvantages of the chimney:

First—The cost is less.

Second—The flue gases can be reduced to a very low temperature, as the heat is not required to produce the draft. The heat loss due to a chimney was shown to be usually between 15 per cent. and 20 per cent. With a mechanical draft this loss can be reduced two-thirds.

Third—This method is safer, as there is no stack to blow over.

Fourth—The draft can be controlled more easily and quickly, which is a very important advantage for many electric power stations.

Fifth—The boilers can be forced far beyond their rated capacity, and they can also be worked below their rating without seriously reducing their economy.

Sixth—The induced draft method removes the necessity of providing an expensive foundation, as required with a chimney.

The disadvantages are that any accident to the fans or driving engine will cripple the plant, and the device needs more or less attention. The fact that the blower engines will take power is not a real objection, for the amount of power required is found to be a very small percentage of the total capacity of the boilers supplied with draft, and is very much less than the usual loss due to a chimney.

As usually designed, the induced draft is obtained by placing a fan of the Sturtevant pressure type in the flue between the boilers and chimney. This fan can be driven in a number of different ways, by an electric motor or a separate engine. The speed can easily be controlled by adapting any of the well-known damper regulators which are worked by the variations in steam pressure. The fan works in gases of about 250 degrees Fahrenheit to 300 degrees Fahrenheit, and therefore must be supplied with water-cooled boxes. The fan must be a large one; its size can be easily determined from the known volume of gases produced by the combustion of a given number of pounds of coal.

Exhausting Steam into the Chimney, the third method of producing draft, is not used in power stations. It is, however, a very effectual method, and is the common way of producing draft on the locomotive, where it is necessary to work the boiler to its highest possible limit and where the question of economy is a consideration second to that of space.

Forcing Air through the Grates is the fourth method of producing draft. It is sometimes employed and finds some friends. It has been advocated to warm the air to a high temperature before allowing it to be blown into the furnace, which idea is not a bad one. The disadvantage of a draft forced into the furnace is that it necessarily increases radiation, and trouble is experienced by the smoke and gases escaping back through the openings where fuel is introduced. Of course with an ordinary hand-fired furnace this would become very objectionable. In marine practice the draft is frequently produced by forcing air under pressure into the stoker room, from which it escapes into the furnace.

With all methods of forced draft it is well to provide some method of shutting off the draft when the furnace is fired, if this firing is done, by hand. This will avoid a great in-rush of air, which, not passing through the fire, contributes nothing to combustion, but serves only to cool off the heating surface, causing tremendous strains and resulting in a waste of fuel.

A combination of induced draft and chimney draft is sometimes adopted—a method which certainly possesses many advantages. In this case a stack of about six-tenths the usual capacity is erected, and the natural

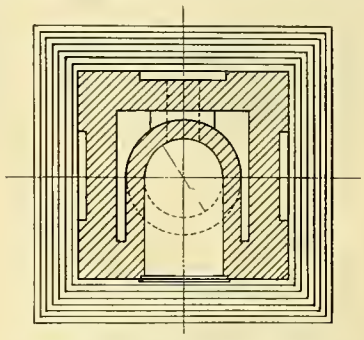

FIG. 8. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL BRICK STACK (CROSS-SECTION THROUGH BASE).

draft is augumented by a blower, so arranged that by means of dampers the plant can be operated with or without the use of the mechanical draft. In this way are secured the advantages of both methods without the disadvantages of either.

[The next lecture, the fourth in the series, relates to "Water Supply, Pumps, Condensers, Heaters, Economizers, etc."]

1. A full discussion of the design and construction of self-supporting metal chimneys, by C. G. Robbins, has been published in *Power* (April, 1897), since these lectures were delivered, and is so complete that it is thought best to omit the necessarily limited discussion of the subject here and refer the reader to that paper.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the Western Electrician.]

Arthur Gibson contemplates putting in a telephone exchange at Windom, Minn.

There is a move on foot at Nevada, Iowa, to secure telephone connection with Boone, via Ames.

The difference between the Iowa Telephone company and the Mutual Telephone company at Des Moines,

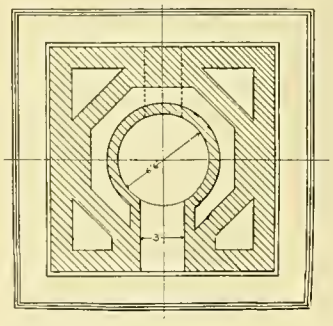

FIG. 10. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL STEEL STACK (CROSS-SECTION THROUGH SUB-STRUCTURE OF MASONRY).

Iowa, has been settled, and both companies are setting poles without interference.

Arrangements are being made to put a telephone exchange in at Primghar, Iowa, this spring.

The Dakota Central Telephone company is preparing to extend its lines from Redfield to Watertown, and other extensions, aggregating about 200 miles.

The Iowa Telephone company is canvassing Newton, Iowa, with a view to establishing a telephone exchange.

A telephone company is being formed at Lake Mills, Iowa.

The Dakota Central Telephone company of Aberdeen, S. D., is preparing to extend its line from Groton to Webster, S. D.

The Cedar Rapids, Ia., independent telephone company has 550 subscribers. It started last fall with 300.

The Northwestern Telephone Exchange company is preparing to branch out from Mankato, Minn., to Wells

and Albert Lea, with a second line to New Ulm and a third to Rochester.

Messrs. Erkel and Berrisford have contracted with the Northwestern company at Le Sueur, Minn., to connect with their system there, and will build a metallic circuit from Le Sueur to Le Sueur Center.

The Grant County Telephone company of Lancaster, Wis., will extend to Montfort and Cobb and there connect with the Dane County company's system to Madison.

The Northwestern Telephone Exchange company will rebuild its line from Stillwater, Minn., to Osceola, Wis., and extend it to Taylor's Falls, Minn., and construct a new line to Hudson and other Wisconsin points.

Panora, Ia., is soon to have telephone connection with every town from Rockwell City to Des Moines.

The West Superior, Wis., Council has granted a franchise to the People's Telephone company.

The Cedar Valley Telephone company is putting in an exchange at Grundy Center, Ia.

An independent telephone company is projected at Mt. Vernon, Ia.

Robert Pritchard of Princeton, Ia., has canvassed Leon, Ia., with a view to establishing a telephone exchange there.

Andrew Ryan has been granted a telephone franchise in Shell Lake, Wis.

The Minnesota House of Representatives has passed a bill taxing telephone companies five per cent., in lieu of all other taxes, by a vote of 75 to 12.

The Council of Green Bay, Wis., has granted a franchise to the Northern Wisconsin Telephone company.

The Seymour, Ia., Telephone company has been incorporated with $2,000 capital stock.

The Des Moines, Ia., Board of Public Works has issued an order that no telephone or electric light company shall place poles or replace old ones without written permission by the board.

The Iowa Telephone company may refuse to establish an exchange in Newton, Ia., as it asked for a 25-year franchise and got one for 10 years.

The Mississippi Valley Telephone company expects to have the exchange completed at Burlington, Ia., in about six weeks.

Casting and Tempering Copper.

The illustration shows the foundry of the Mitchell Tempered Copper company of Corry, Pa., where tempered copper castings are made for electrical appliances, especially commutator bars and segments. The ingots of copper come from the famous Calumet-Hecla mines of the Lake Superior region, and, after being melted, the metal is run into molds under the supervision of Capt. Dan Mitchell, the "copper genius" of the plant, as shown in the picture. Skilled molders are employed, and great care is taken to insure accuracy, so that the user is not required to plane or file the copper parts in setting up. Capt. Mitchell is also very careful about the tempering, which insures the durability of the product, and here his long years of experience are of great value. The cores are baked in a steel oven, which is heated by natural gas. The shop has a capacity of 1,500 pounds of finished copper daily, and is so arranged that its capacity could be doubled in ten days should business warrant. The claim is made for the castings of this company that they are tempered evenly, being free from blow-holes and sand washings.

Capt. Mitchell, the superintendent of the company, was originally with the Mitchell-Braudt company of Erie, Pa., which produced the well-known M. & B. copper. The works of the Mitchell Tempered Copper company were opened on June 24, 1896, and it is said that wherever the product has gone it has given satisfaction. J. G. Ruhl, the secretary and treasurer of the new company, is an old-time railroad man, well known throughout the country.

CASTING AND TEMPERING COPPER.

Progress of Bone-grafting Disclosed by Sciagraphs.

By Orrin E. Dunlap.

On January 1st an air drum burst in the carbide works at Niagara Falls, and as a result of the accident the left leg of Mr. F. H. Moir, the foreman, was badly shattered. The fracture was an unusually bad one, and the doctors who were called found it extremely hard to treat. Doctors William H. Hodge and William C. Cross were called, and at first it was thought the leg would have to be amputated. A few days passed and a close examination and careful consideration led them to believe there was a slight chance of saving the leg. Unusual care in nursing the patient was given, and during the latter part of January Mr. Moir was removed to the Lexington Heights Hospital, Buffalo. It was apparent to the doctors that the ordinary methods of instituting a new bone growth so as to secure a proper joining of the bones were out of the question, and so, when Moir was removed to the hospital, it was decided to try the experiment of bone grafting. The operation was performed by Doctors William H. Hodge and William C. Cross of Niagara Falls and Dr. D. G. Wilcox of Buffalo. They grafted to the two ends of the broken tibia a piece of bone from the femur of a sheep. A piece of bone five inches long was placed in the tibia, the wound carefully sewed up and the leg placed in a plaster cast, an opening of sufficient size being left to allow of the proper examination and dressing.

The operation was a truly remarkable one and has attracted the attention of physicians all over the country, who are watching with great interest the final outcome. The sciagraph of Mr. Moir's leg herewith reproduced shows its condition just 41 days after the operation. The story told by this picture assures the doctors in attendance on Mr. Moir that the operation is destined to prove a success in every way. The five-inch sheep bone inserted in the leg is plainly seen and shows that it is taking life and making rapid strides toward the process of repair. The new growth can be traced along the line of graft. The growth is to be seen extending from both ends. At either end of the sheep bone the growth is very clearly defined, while around the entire graft an organized blood clot has formed, through which numerous bone cells can be traced. This clot will in time become a bony mass, and the leg will be restored and the success of the operation complete.

Physically, Mr. Moir is in the best of condition. His appetite is good, and his temperature is normal, showing that the inserted bone has taken life and is being properly sustained. The new bone hardens and takes on vitality as the growth extends toward the center. It will, of course, take some little time for the bone to complete the growth, and for it to harden in order to make the leg secure. However, the leg will within a few weeks be placed in a heavier cast, and Mr. Moir will be able to move about aided by crutches. It will be months before he will be able to use the leg unassisted by crutches.

The large dark bones seen in the picture are the upper and lower portions of the tibia of Moir's leg. The narrower dark bone connecting them is the inserted sheep's bone. The dark spot over the sheep bone is an organized blood clot, while the lighter shade surrounding the sheep bone represents the bone cells. Outside of this still is to be seen a lighter shade which represents the skin and muscular tissue.

PROGRESS OF BONE-GRAFTING DISCLOSED BY SCIAGRAPHS.

The operation is remarkable because of the use of a sheep's bone and for the size of the piece of bone engrafted. Doctors Hodge, Wilcox and Cross are very much pleased over the prospective result.

His Own Telegraph Messenger.

[From the *Boston Evening Record.*]

A drummer who travels in Maine is not greatly impressed with the rapidity of the telegraph service in that state. Recently he was in the upper part of a county and wanted to reach another town that night. He telegraphed the hotel keeper in the latter place early in the day to send a team to the station for him. When he reached the station at night no team was there, so he started to walk to the village, which was quite a little distance off. No sooner had he started than the station agent said to him. "Are you going to the village?" "Yes." "Then I wish you would take a dispatch up to the hotel." It was the dispatch ordering the team.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

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By a clear majority of the votes cast at the recent election, Carter H. Harrison is wielding the great power placed in the hands of the mayor of Chicago. His record in executing the trust reposed in him by this decisive choice will determine, so far as any man can foresee, his future in American politics, or, more than that, in American history. On the one hand, he can administer his office with such honesty, justice and broad-minded capacity that the people may demand his service in higher places. The man who was president of the United States two months since was making a record as mayor of a city of much less importance than Chicago 17 years ago. But, on the other hand, a failure to recognize the spirit of the time—a neglect of manifest opportunities for civic advancement and the improvement of the public service—can hardly fail to result in a blighted career and disappointment to thousands of Chicagoans who wish only honor and success for their young mayor.

In this situation it is most important for Mr. Harrison to give grave attention to the affairs of the City Telegraph Department, which are in such condition that the mayor's treatment of them will go far to make or mar his administration. The corporation counsel holds that the incumbent of the office of superintendent of this department does not come within the exemptions of the civil service law, and that the mayor has the power to appoint the superintendent. As this seems to be settled, the question will naturally arise, Shall John P. Barrett, the present incumbent, be retained, or shall there be a new superintendent and an infusion of new blood? Representing the electrical interests of Chicago, the WESTERN ELECTRICIAN asks for a change.

It is hardly necessary to state that Mr. Barrett's record is bad. There is no doubt on this point. If the mayor, coming with judicial mind, desires confirmation, let him ask the electrical dealers and contractors of Chicago, who would like to sell their best goods to the city at their best prices; let him ask union labor, which Barrett has "turned down" repeatedly, as shown by the action of the Brotherhood of Electrical Mechanics; let him ask the insurance interests, which have repudiated Barrett and his methods of electrical inspection, and finally let him appeal to the sense of honesty and decency in this community, which Barrett has outraged.

John P. Barrett is a load which Mayor Harrison cannot afford to carry. He is a heritage from former administrations; and he will be the target for richly deserved criticism so long as he remains in the city hall, for he has made his position serve his private ends for many years. His removal will be hailed as a bright omen for the new administration, as it will be emphatically in line with the spirit of the mayor's ante-election pledge, "I shall not favor special contractors to the detriment of the taxpayers." By no single act, perhaps, can Mayor Harrison so clearly show his intention to keep faith with the people as by allowing Barrett to drop into well-merited oblivion. A contrary course will produce a painful impression on the honest electors of Chicago, as "Barrett's methods" are now well known.

In short, every consideration of honesty, every consideration of public duty, every consideration of practical politics even, demand that Mayor Harrison dispense with the services of John P. Barrett. There is no lack of good men from whom the new superintendent can be chosen. Let the mayor make his choice, and the electrical fraternity will acquiesce in it.

ACCORDING to the present indications electric railway construction will be the feature of the year in New York and Chicago. The desire of the great metropolitan companies to avail themselves of the advantages of electricity is really astonishing to those who have experienced the coolness with which these projects were formerly contemplated by these corporations.

AS A result of the recent flood in East St. Louis the street railway company was called upon to furnish transportation for a funeral party. The street in which was the home of the deceased was flooded, and neither carriages nor hearse could get near the house. The street car company was appealed to and it furnished two trolley cars. One was used for a hearse and the other was utilized by the mourners. The journey to the gates of the cemetery was made in this manner. Trolley cars have been used in Chicago for similar purposes and with very satisfactory results. The plan has many commendable features.

THE *Trade Journals' Review* of London gravely states that, recognizing the need, the corporation of Boston "has introduced small portable [electric] heating stoves, and among other articles a small laundry iron of convenient form, specially designed for ironing laces, handkerchiefs, and other light articles." If this were true it would instance a paternalism beyond the sanguine hopes of the most enthusiastic advocate of municipal ownership. But it is not true, being merely an example of journalistic inaccuracy of the English variety. The articles mentioned are introduced by a private corporation doing business in the city named.

ALTHOUGH comparatively little progress has been made in the development of electric lighting in Canada, the politicians of the Dominion evidently have not been slow to realize the opportunity presented in this field, and they are laying their plans to gain control of the business. A bill now before the Ontario Legislature threatens the very life of the electrical enterprises of the province, and it is time for the corporations thus assailed to take measures to protect themselves. The Canadian Electrical association presents an excellent means of organizing the opposition to measures of this kind, and the interested parties will find that the only effectual means of heading off adverse legislation is to present a solid front against these encroachments. Experience in this country proves the wisdom of united effort against such measures as that now under consideration.

WE commend to the earnest consideration of our readers the able article on "Industrial Education" by Prof. R. H. Thurston of Cornell University, which appeared in a recent issue of the *New York Tribune* and is reproduced elsewhere in this issue. Prof. Thurston directs attention to the conditions that prevail to-day in Germany and draws a valuable lesson from the experience and accomplishments of that country. He declares that technical education has given to Germany as a nation a pronounced advantage over England, and he points out the danger of the United States unless similar methods are adopted here. Prof. Thurston does not underestimate the value of the work now being done in the institutions of this country devoted to industrial education, but he says that our system lacks persistency, consistency and complete extension. The false sense of security which pervades the community is to blame in a large measure, he believes, for the neglect of this important subject, but he is pleased to note unmistakable signs of an awakening, especially in the western states, which "are becoming interested in the work and promoting it magnificently, as a matter both of common prudence and sensible politics, and as a matter of state pride." He acknowledges that the state universities of the country, between the Ohio and the Pacific, are leading in this regeneration of the modern state.

REDUCED street railway fare is an important issue in many communities, especially in the West. Just now Indianapolis is the scene of a war upon street railway interests by advocates of the three-cent fare movement. At the recent session of the Indiana Legislature a law was passed reducing street car fares in Indianapolis from five to three cents, and the act went into effect on April 15th. The company was advised that the law was unconstitutional and suit is now pending in the United States Circuit Court, in which ex-President Harrison appears for the company, asking for an injunction against the enforcement of the three-cent law. In the meantime the people refused to pay more than three cents, and after a conflict lasting a couple of days the company determined to accept three cents under protest. Supporters of the new law are apprehensive that it may be successfully claimed that it abrogates a contract with the city, made when the charter was granted, that the fare should not exceed five cents, with no stipulation that it should be lower. The Legislature having enacted that the franchise of the company extends to 1901, it naturally follows, the company says, that this contract holds good until that time.

In this state objection is made to the Humphrey bills, just passed by the Senate and now pending in the House, because they take the control of the street railways out of the hands of the cities, towns and villages in which they operate and place them under the direction of a state commission; extends the life of existing franchises 50 years and make the legal rate of fare five cents for that period. Competition will be shut out and this will remove the last hope of the people to secure concessions, it is claimed.

It is rather singular that while the people of Indianapolis were obliged to look to the Legislature of the state for assistance in their crusade for cheaper transportation, the people of Illinois seem to consider it necessary to organize in opposition to the proposed action of the Legislature. The latter body, however, has shown a disposition to exert the power conferred upon it, and enact such measures as it deems necessary.

Taxation of Poles.

An Illinois subscriber writes that the City Council of Champaign is undertaking to collect a special tax or license on every street railway, electric light and power pole placed in the streets. He says that the company already pays ample tax on every bit of real and personal property which it owns, as well as a capital stock tax, and wants to know if this additional imposition is legal.

The leading case on this subject is undoubtedly that of the city of St. Louis against the Western Union Telegraph company, which twice had the consideration of the Supreme Court of the United States, namely, March 6 and May 15, 1893. An ordinance had been passed, one section of which provided that "From and after the first day of July, 1884, all telegraph and telephone companies which are not by ordinance taxed on their gross income for city purposes shall pay to the city of St. Louis, for the privilege of using the streets, alleys and public places thereof, the sum of $5 per annum for each and every telegraph or telephone pole erected or used by them in the streets, alleys and public places in said city." This the Supreme Court held to be valid.

In its first decision, the court called special attention to the fact that, regardless of how it might be characterized, what was really charged was, as it viewed it, a rental for an absolute, permanent, and exclusive use of so much public property as the space occupied by the poles in the streets constituted. And, even though the poles were the property of an interstate commerce company, given its franchise by Congress, the court maintained that the city could insist upon reasonable compensation for the space in the streets thus exclusively appropriated, though what would constitute reasonable compensation, it held, was a matter for inquiry in the courts, and changeable with circumstances.

On the rehearing, particular notice was taken of the ample power vested in the city of St. Louis, by its charter, to pass such an ordinance. Especially, did the court say, it was given power to open and establish streets, to improve them as it saw fit, and to regulate their use, paying for all this out of its own funds. And it reasoned that it was only a matter of regulation of use when the city granted to the telegraph company the right to use exclusively a portion of the streets, on condition of contributing something toward the expense it had been to in opening and improving these streets. Unless, therefore, the telegraph company had some superior right which excluded it from subjection to this control on the part of the city over the streets, the court said it would seem that the power to require payment of some reasonable sum for the exclusive use of a portion of the streets was within the grant of power to regulate the use.

Among the states Pennsylvania seems to have had the most litigation over this subject. There the power of a city or town to impose a tax upon the poles of electric companies is affirmed as a valid exercise of the police power, to remunerate it for the expense of maintaining a supervision over the poles and electric wires, unless the charge be too excessive, yet giving considerable latitude with regard to the amount.

Likewise, the Court of Appeals of Maryland held on June 21, 1894, in the case of the Postal Telegraph-cable company against the mayor of Baltimore, that a city having the right to regulate the use of its streets might impose a tax of $2 on any pole which should be used in any of the streets or alleys.

But there is oftentimes a vast difference between the conditions that can be imposed before and after the occupation of a portion of the public streets for authorized uses. This is brought out by the decision of the Supreme Court of Louisiana, rendered in 1888, in the case of the city of New Orleans against the Great Southern Telegraph & Telephone company, holding that the right to occupy the streets having been granted without any claim of rental or recompense, and no supervision of the poles by the city being shown, a tax of $5 per pole was illegal. And the Supreme Court of the United States, citing that decision, stated that it was but an application of the well recognized doctrine of the authorities since the Dartmouth College case to say that, if a city granted authority to set poles, when accepted and acted upon, it became an irrevocable contract, which the city would be powerless to set aside, or interpolate with new and onerous considerations. This point was not involved in the St. Louis case, as nothing tending to constitute such a contract was shown. Without it the court decided as stated.

Another very important decision is that handed down by the Supreme Court of Mississippi, in 1895, in the case of the City of Meridian against the Western Union Telegraph company. This court recognized the authority of the decisions of the Supreme Court of the United States, but called attention to the fact that the city of St. Louis appeared to be the absolute owner of the fee in its streets, and had unique charter powers. It also pointed out that, in Mississippi, by act of 1886, it was provided that any telegraph company should, upon certain prescribed conditions, "have the right to construct, operate and maintain telegraph lines * * * * on, across, or along all * * * * streets," without any provision being made for compensation to cities and towns. For these reasons, it held void an ordinance said to be a copy of that of St. Louis, particularly emphasizing that it was in contravention of the statute just quoted, which it said was "doubtless passed at the instance of telegraph and telephone companies," but which it felt bound to be governed by none the less.

Now, what about the validity of the Illinois ordinance? Too little information is furnished for one to pronounce an opinion on it. But this survey of the decisions, and the suggestions drawn from them, it is hoped, will enable anyone, with the proper data, to form a reasonably good opinion on the subject for himself. There does not appear to be any Illinois decision applicable. The statutes give the city councils power to "regulate" the use of streets and alleys, and to regulate and prevent the use of streets for telegraph poles, etc. They also provide for construction and maintenance of private telegraph and telephone lines, as well as public telegraph lines, but for the latter corporate consent must be obtained. And lapse of time, they further provide, shall not give rise to any presumption of a grant of right to use land for poles.

Concrete Foundations for Street Railway Tracks.

The Rochester, N. Y., Railway company has under consideration the advisability of adopting a new system of putting down rails, which, if it comes into general use, will give the time-honored wooden tie a back seat. The system proposed makes each rail of the track independent, and provides for a continuous prism of concrete under each rail nine inches across at the top, widening to 13 inches at the bottom and 17 inches in depth. The rails are to be laid directly on the concrete and fastened in place by iron yokes which compass the concrete at distances of four or five feet.

The originator of this system is Peter Heyners, and its use has been authorized in Syracuse, where contracts for five miles of construction in this manner have been awarded, under an ordinance of the Common Council directing that an indestructible tie or foundation be laid. It is claimed for the system that its first cost is less than that of the present standard of construction, which is for ties laid on a concrete filling, with a nine-inch girder rail, made necessary to get the ties down deep enough to enable the pavement of stone blocks to be laid over them. It is further claimed that a roadbed laid in the manner proposed is practically indestructible, and therefore there will be no periodical disturbance of the pavement for the purpose of making repairs, and that absolute rigidity is secured, with no play between the rail and the pavement adjoining.

Storage Battery Traction Approved in Germany.

Apropos of the experiment now under way in Chicago, the following statement, taken from the *Electrical Engineer* of London, is of particular interest:

The directors of the Hanover tramway system have published an important report, in which they narrate their experiences with accumulators as the source of the power for their cars. In Hanover both overhead wires and accumulators have been used for a considerable time, so that the managers are in a position to institute a reliable comparison. Taking everything into account they pronounce in favor of the storage cell. The cost of maintenance, they say, has been determined with the utmost exactitude possible for the year 1896, and the average comes out at 40 marks per wagon per month, equivalent to 75 groschen per kilometer. The estimate includes the cost of renewing the plates. Having regard to the expense involved in the maintenance of the overhead line and its accessories, as well as to other circumstances, the managers reach the conclusion that the additional cost of accumulators does not exceed one groschen or one-tenth of a penny per mile. Consequently it has been decided that the entire system shall, as soon as the requisite arrangements can be made, be driven by secondary batteries.

Cumberland, Wis., is considering the question of electric lighting.

Congressional Bills on Electrical Matters.

Legislation of an electrical nature as mapped out in the bills introduced in Congress lately may be summarized as follows:

By Mr. Loud of California: A bill to facilitate the construction and working and maintenance of telegraphic communication between the United States, the Hawaiian Islands, Japan and Australasia, and to promote commerce. This bill authorizes the postmaster-general to contract with the Pacific Cable company of New Jersey for the payment by the United States of a subsidy not exceeding $60,000 per year for the governmental use of the company's cables.

By Mr. McEwan of New Jersey: A bill to revive and amend and extend the act of Congress of August 15, 1876, to encourage and promote telegraphic communication between America and Asia, across the Pacific ocean, from the western shores of the United States to the Hawaiian Islands, to Japan and China. This is practically a revival of the grant to Celso Cæsar Moreno and his associates for submarine cables to the points named.

By Mr. Bennett of New York: A bill to facilitate the construction and maintenance of telegraphic communication between the Hawaiian Islands and Japan and China. This is to permit the Pacific Cable company, a corporation organized under the laws of the state of New York, to lay the cable from San Francisco to the points named.

By Mr. Frye of Maine: A bill to regulate the establishment of submarine telegraphic cable lines or systems in the United States, as follows: That the shore end of any new submarine telegraphic cable line or system that shall be established after the passage of this act, and shall be protected in any foreign country by exclusive landing rights or by any other special privileges or franchises, shall not be permitted to be landed or operated on the territory of the United States until the consent of the Congress of the United States shall have been obtained therefor. But this prohibition shall not apply to the renewal or renewals of any submarine telegraphic cable or cables now in operation.

By Mr. Butler of North Carolina: A bill to establish a postal-telegraph and telephone system, and to enlarge the postal facilities of the people of the United States.

By Mr. Hepburn of Iowa: A bill to incorporate the Columbia Telephone company. John D. Langhorne, Benjamin Butterworth, John A. Baker, Tallmadge A. Lambert, T. Cushing Daniel, J. E. Keelyn, W. G. Waggaman and Thomas Arnat of the District of Columbia, are named incorporators.

By Mr. Gillett of Massachusetts: A bill to protect state anti-gambling laws from multiplication through interstate gambling by telegraph, telephone or otherwise.

By Mr. McMillan of Michigan: A bill to incorporate the East Washington Heights Traction Railway company of the District of Columbia.

By Mr. Jones of Washington: To authorize David B. May of the state of Washington and his associates to construct and operate an electric railroad in the Yellowstone National Park, for hauling passengers and freight.

By Mr. Wheeler of Alabama: A bill granting to the Musssel Shoals Power company, a company created and organized under the laws of the state of Alabama, the right to erect, construct, operate and maintain dam or dams, inlet and outlet races or canals, and power station or stations, in the Tennessee river at Mussel Shoals, Alabama.

By Mr. McMillan of Michigan: A bill to authorize the Washington & Glen Echo Railroad company to obtain a right of way and construct tracks into the District of Columbia 600 feet.

By Mr. Rixey of Virginia: To provide for widening the Aqueduct bridge, and laying thereon a single track for an electric street railway use.

By Mr. Cullom of Illinois: A bill providing that the Metropolitan Railroad company be required to extend its lines of underground electric railroad by double track from its present chartered terminus on Columbia road to Eighteenth street, thence northward to Howard avenue, thence eastward on Howard avenue and Lydecker avenue to Tenth street (Sherman avenue), thence southerly on Tenth street to Florida avenue, connecting with the northern extension of the Ninth street line of the company.

Electric Railway Service in Western Chicago Suburbs.

The Suburban Railroad company, which leased the Harlem branch of the Chicago & Northern Pacific last fall, is urging forward the work of changing the line into an overhead trolley line. This road is operated by Naugle, Holcomb & Co., the construction company which is installing the electrical equipment, and this company will operate the line for two years. The overhead trolley wire is all strung, and 24 of the new cars to be used are built and ready for the rails. In a short time the power house, which stands at the corner of Harlem avenue and West Twenty-second street, in Cicero, will be finished, with all its machinery installed, and the electric suburban service will be put in operation about June 1st. The Suburban Railroad company will lease a dozen light passenger cars from the Chicago & Northern Pacific and use them as part of the equipment of the road. The company is building branch lines to Berwyn, Riverside and La Grange, and has in contemplation lines to other towns. The Harlem branch formerly was the old Chicago, Harlem & Batavia dummy line. At Fortieth street and Colorado avenue the Metropolitan elevated road crosses the new electric line, and

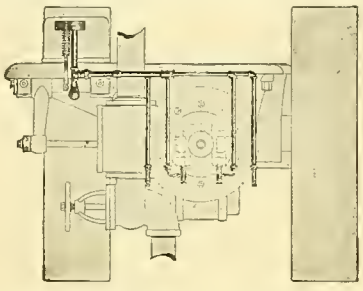
the trains of the Suburban company will climb up to the "L" grade on an inclined plane. As the motor cars will be fitted for both the overhead trolley and third-rail systems, they will be able to come over the Metropolitan tracks to the Union Loop. It is probable that passengers from all points west of the elevated terminal will pay seven cents for the ride through to the business center.

Proposed Ferraris Memorial in Turin.

A committee of influential Italians has been formed to raise funds to erect a suitable memorial to the lamented Galileo Ferraris in the city of Turin. The WESTERN ELECTRICIAN is in receipt of a circular from Count Rigoon, the chairman of the committee, and C. Montu, the secretary, stating that contributions for this worthy object will be gladly received from scientists and electricians all over the world. It is proposed to place the memorial in the Royal Industrial Museum of Turin, in which is the electro-technical school that Ferraris established.

Automatic Lubrication.

The accompanying cuts illustrate the system of automatic lubrication, which is applied to the American-Ball engines, now being built at Bound Brook, N. J. The



AUTOMATIC LUBRICATION.

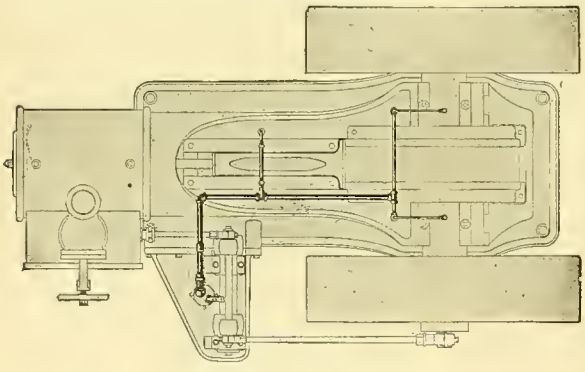
characteristic features of this system include a positive circulation of oil from an external storage tank, into which the oil is strained on its return from the engine frame, and an entire separation of the water from the oil by means of a tight bulkhead near the cylinder end of engine frame. The chamber thus formed collects the water dripped from piston rod and discharges it through a suitable drip pipe while the steam escapes at the top of the chamber, which is open to the air.

A simple pump placed in the storage tank and actuated from the rock shaft circulates the oil through suitable pipes and discharge nozzles to the stationary working surfaces, from where it flows by gravity or centrifugal force to the crank-pin and cross-head pins through oil holes and channels provided for that purpose, and thence by gravity back to the storage tank, on entering which it passes through a fine gauze strainer located in the tank.

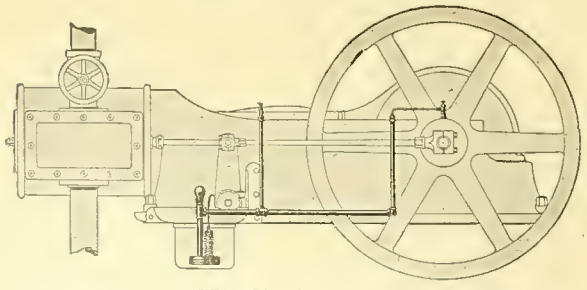
To insure an abundant supply of oil at the discharge nozzles the pumping capacity is made to exceed the maximum requirement, and the surplus oil, escaping through a relief valve, falls back into a storage tank.

To provide against possible derangement of the pump a gravity receptacle is arranged to be instantly attached to the system as an emergency supply.

A liberal supply of oil fed automatically to the working parts of an engine contributes wonderfully to smooth, quiet running, and relieves the engineer from the drudgery of watching and refilling a lot of oil cups.



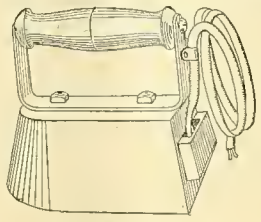
AUTOMATIC LUBRICATION.



AUTOMATIC LUBRICATION.

Hatters' Iron.

The cut shows the conventional form of hatters' iron, which the American Electric Heating corporation of



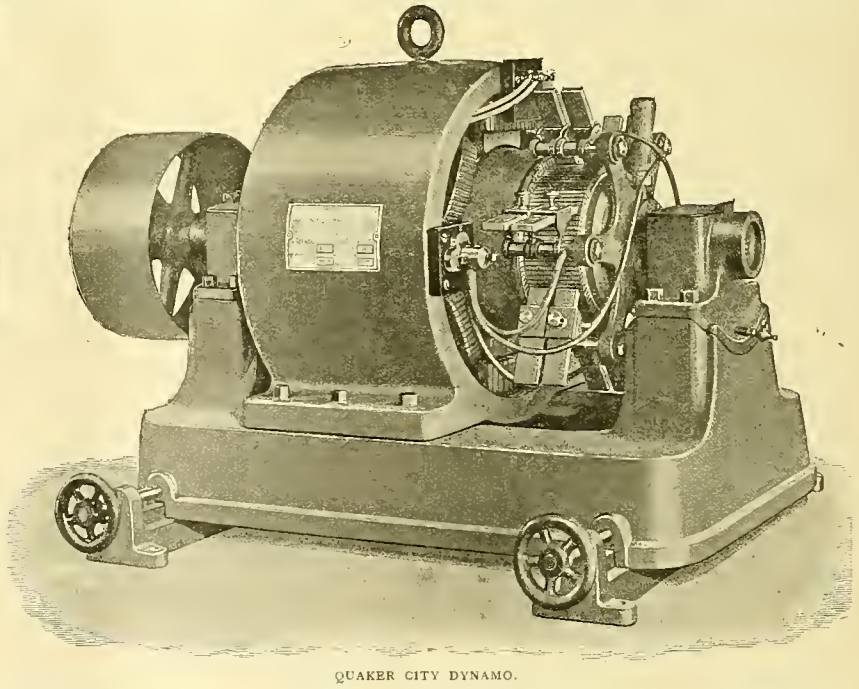
HATTERS' IRON.

Boston supplies with electrical heating equipment. The iron has polished sides and is used in many of the large retail establishments throughout the country, as well as by manufacturers. By using electricity it is kept perfectly clean at all times, heats quicker than by other means and effectually does away with leaky gas connections and other objectionable features incident to the older methods of heating. It is made for all lighting voltages.

Quaker City Dynamo.

The illustration shows the direct current multipolar dynamo made by the Quaker City Electric company of Philadelphia. A recent circular gives these descriptive details:

The construction of these machines throughout is solid substantial and compact, with low center of gravity and the weight properly distributed over an ample bed-plate. They are fitted with all essential modern improvements. The bearings are self-oiling, with large bronze metal bushings and double oil rings in each journal. The magnet coils are machine-wound, on standard forms, and slipped over pole pieces, allowing absolute interchangeability. The field rings, being separable from the bed-plate, may be mounted on special bed-plates for direct connection to any of the standard types of automatic engines. The machines are first-class in every detail, smooth running, of highest electrical efficiency, and capable of developing their full rated output without overheating and, owing to the generous proportions of the commutator and brush capacity, without sparking. The shaft upon which the armature core is mounted is very heavy, and the laminated core itself is solidly built and slotted to receive the winding. While both ends of the core are practically enclosed, there are openings in the fiber head which communicate directly to the interior of the core, affording exceptionally effective ventilation. Special attention is also called to the commutator, which is massive and most perfectly made. The materials used are tempered copper segments with mica insulation. The segments are very deep, affording large available surface for wear, and the generous proportion of the whole insures faultless operation under all conditions. The winding is accurately done in the slots arranged for the purpose, and is carefully insulated from its surroundings. In its entirety the armature is excellently proportioned, perfectly balanced and is in all respects equal to the most stringent requirements of modern armature construction.



QUAKER CITY DYNAMO.

Electric Railways in Vermont.

The outlook for the approaching season in Vermont for electric railway building is good. A project is under way to build an electric road between Hinesburg and Burlington. Another which bids fair of success, and will probably be carried out if a charter can be secured, is for a road from Burlington to Grand Isle. It is quite certain that the Montpelier and Barre line will be built this season. The St. Johnsbury road is also expected to be built this summer. The Rutland electric road is reported to be in a flourishing condition, and the outlook for the Bennington and Brattleboro line is flattering.

The Glad Hand.

The accompanying illustration shows the Davis indicating globe, manufactured by the Phœnix Glass company of 42 Murray street, New York. This device is 11 inches in length, and is made to fit a 3¼ inch holder. It covers an incandescent lamp perfectly, and will be

THE GLAD HAND.

found especially useful in hotels, office buildings, boats, etc. It is manufactured of opal, ruby and flesh-tinted glass. The letters are clearly cut, and can be seen a long distance, either by day or night, and any lettering that is desired can be etched upon the globe. The name which has been given the globe is the "glad hand."

Electrical Supplies Wanted by the Government.

Sealed proposals are being invited until May 6th for furnishing the Agricultural Department with telegraph and instrument supplies during the next fiscal year. Full information can be obtained upon application to James Wilson, secretary, Washington, D. C. The public printer is inviting sealed proposals until May 6th for furnishing the Government Printing Office with electrical supplies during the next fiscal year. Additional information can be obtained by addressing F. W. Palmer, public printer, Washington, D. C. Sealed proposals are being invited until May 6th for furnishing the Office of Public Buildings and Grounds, Washington, with electric battery supplies during the next fiscal year. Information can be obtained by addressing Col. T. A. Bingham, U. S. A., Washington, D. C.

It is reported that Algona, Iowa, will endeavor to secure electric lighting from the Britt, Iowa, plant.

Pelton Water Wheels in India.

The Pelton Water Wheel company of San Francisco and New York is one of the comparatively few houses in this country that appreciate the value of a foreign market for their products. One of the most effective means of securing this market has been that of keeping a corps of well-trained engineers in the field, making surveys and installing work in any part of the world

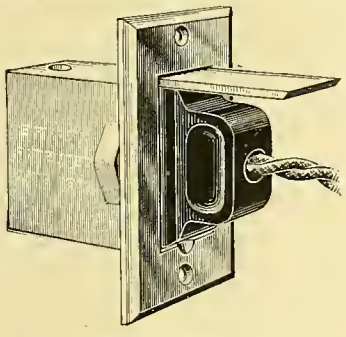
PELTON WATER WHEELS IN INDIA.

where such service is required. The illustration shows one of these with native assistants making a survey for an electric power plant in far-away India.

Not long ago the Pelton company supplied an extensive equipment for working the Ruby mines in India, and more recently shipped several power plants to various points in the East Indies, designed for running the machinery of tea and coffee plantations which abound in that locality. Water is available for power to an almost unlimited extent in all these tropical countries, and it only needs intelligent engineering to make it subservient to use by all modern and economic methods.

Chapman Receptacle.

The cut shows the Chapman receptacle, a wiring device that has met with much approval, although it has been on the market only a little over a year, and which



CHAPMAN RECEPTACLE.

is now manufactured exclusively by the Bryant Electric company of Bridgeport, Conn., by a recent arrangement entered into with F. A. Chapman, the patentee. The receptacle is said to have received the endorsement of the underwriters and to have been adopted for use in some of the finest office buildings in the country. So far it has been made in one form only—that shown by the illustration—but it is the intention of the Bryant company to introduce several new designs and improvements.

Hill Switches.

In the accompanying group illustration are shown nine types of standard knife switches made by the W. S. Hill Electric company of New Bedford, Mass. Referring to the numbers, the switches are thus designated:

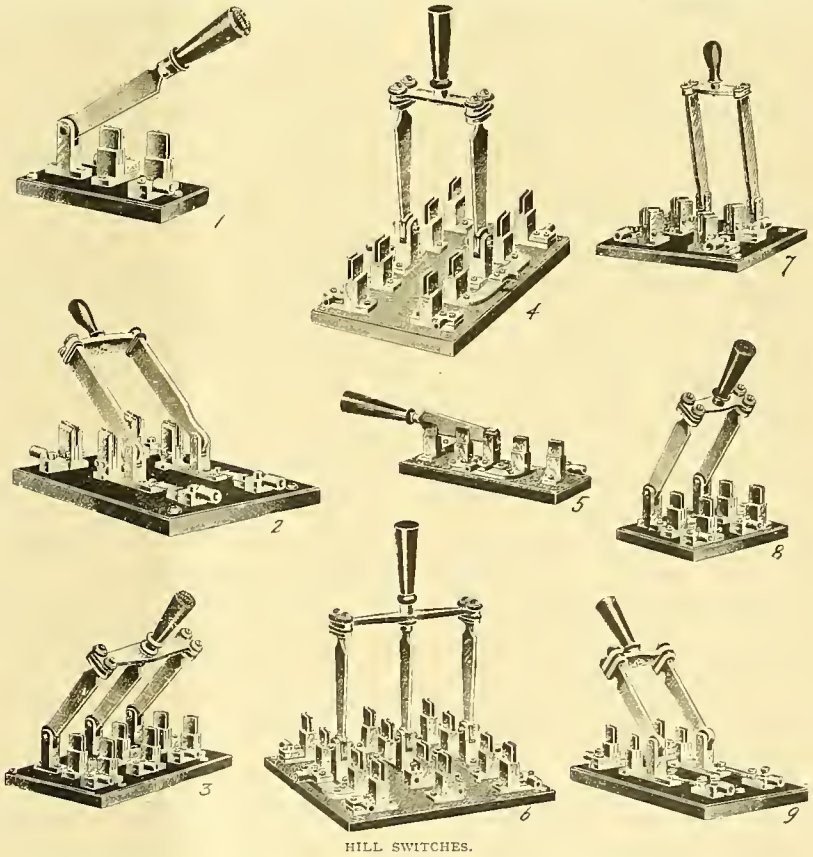
1. Single-pole, single throw.
2. Single-pole reinforced contact, with fuse.
3. Three-pole, single throw.
4. Double-pole, double throw.
5. Single-pole, double throw.
6. Three-pole, double throw.
7. Double-pole, single throw, reinforced contact.
8. Double-pole, single throw.
9. Double-pole, single throw, with fuse.

The Hill company makes many styles of switches—standard knife, reinforced contact, all-copper, single-break, quick-break and several other styles of special switches for high potentials, converters, car heaters, etc. It also manufactures fuse blocks and links, switchboards, rheostats and switchboard connections. The Hill switch has a good reputation, and from the many designs shown a selection can be made for almost any use. The company has just issued an exhaustive catalogue and price-list of 85 pages, clearly printed and illustrated and bound in an attractive cover of black and gold. This is said to be the most complete switch and switchboard catalogue ever issued, and a copy of it will be sent free on application.

Municipal Lighting in Canada.

[From the *Canadian Electrical News.*]

A bill now before the Ontario Legislature gives municipalities of less than 5,000 inhabitants the power to issue 30 year debentures for the purchase of electric lighting apparatus. The bill received considerable opposition in committee on the ground that the life of an electric plant is at longest 20 years, and that the time at which the debentures should mature should correspond to that at which the investment representing the proceeds of such debentures would be wiped out. The advocates of the measure urged 30 years on the ground that this would correspond with the period allowed for water works debentures, and would enable small municipalities which could not afford to construct and operate water works alone, to reduce the operating cost by combining with the water works electric lighting. The mayors of several interested municipalities appeared before the committee to urge the passing of the measure. The owners and managers of electric lighting companies should be able to see in this legislation the trend of events, the manner in which their interests are likely to be affected, and the necessity for greater watchfulness and united effort in the direction of self-protection. The Canadian Electrical association has done, and is doing, what it can to guard the interests of the electrical companies against hostile legislation. If the electrical companies whose interests it is looking after will give the association their united and hearty support, a great deal may be done to protect the investments of those engaged in the electrical business. One thing to our mind appears clear, viz., that legislation should at once be enacted compelling municipalities who may desire to do their own lighting to purchase by arbitration the plant of the existing private company. If this is not done hundreds of thousands of dollars of private capital invested in electrical machinery will be wiped out of existence. An electric lighting company differs from other manufacturing companies in this, that it cannot easily change its location. Each town has its own lighting company, whose plant has been purchased with a view to the special requirements of a particular locality; there would be difficulty in finding another opening were the company forced to change their location, and if an opening were found much of the apparatus would become valueless, inasmuch as it could not be adapted to the new conditions, and a large amount of new material would have to be purchased. For this difficulty of making a change of location is due the fact that prices for electric lighting have been forced down far below a fair basis. The municipalities have known the disadvantage at which they held the companies, and have not been slow to take advantage of it. It is time, as already stated, that those who have invested their means in the electrical business should awake to united effort for their self-protection.



HILL SWITCHES.

Cheap and Costly Telegraphing.

[From the *Chicago Times-Herald.*]

Telegraph rates vary greatly in this country, owing to the immense distances. In many of the smaller countries of the Old World a uniform rate is made for any point within the given country, but it would be manifestly unfair to the American telegraph companies if they were compelled to send a message from New York to San Francisco for the same rate that they charge for a message from New York to Jersey City or from Chicago to Evanston.

As a rule, the minimum rate for a day message of 10 words in this country is 25 cents. A great many points in Illinois, Indiana, Michigan, Pennsylvania, Wisconsin, Iowa and other states in the Mississippi Valley may be reached from Chicago for this rate. Any point in Illinois may be reached for 35 cents. A message to Boston costs 50 cents, while New York, Philadelphia and Baltimore have a 40 cent rate. The highest rates from Chicago are those for points in Southern Florida—85 cents. It costs only 75 cents to telegraph to California or Oregon and the rate for New Orleans is 50 cents.

Few persons who have not experimented with telegraph tolls appreciate the expense of cable communication. Cable rates are so much per word, instead of per message of 10 words, and the figures are very much higher. Messages to England, France and Germany cost 31 cents per word from Chicago. Belgium's rate is 36 cents; Holland and Italy, 38 cents; Austria, 40 cents;

Greece, 44 cents; Egypt, 62 cents; Switzerland, 36 cents; Sweden, 45 cents. Turkey, 43 cents and 53 cents; Russia, 49 cents.

The Cuban war has greatly increased the volume of telegraphic business in the West Indies. The lowest rate is 40 cents per word for messages to Havana. Other Cuban points are higher, and no towns in the West Indies outside of Cuba can be reached for less than $1.05 per word. Messages to Porto Rico cost $1 85.

Central American rates range from 50 cents (Guatemala) to 75 cents (Costa Rico and Nicaragua). South American rates take a big jump upward. Brazilian messages cost from $1.35 to $1.87 per word; British Guiana costs $2.17.

Communication with Australia is expensive. Queensland reaches the highest figure, $2.62 per word, while South and West Australia rates are $1.47 Messages to China cost $2 02 per word, and the same figures apply to Corea. Japanese rates are $2.27 per word; Java, $1.53; Formosa, $2.27; India, $1.29; Madagascar, $1.70; New Zealand, $1.58; Philippine Islands, $2 51; Siam, $1.51. African rates are lowest for points along the Mediterranean and highest along the west coast. Algeria can be reached for 38 cents per word, the minimum rate for the Dark Continent. East African rates are $1.54 and $1.64, while South African points range between $1.58 and $1.70. West African points, as a rule, range above $2, while it costs $3 02 to send a word to Mossamedes from Chicago—more than to reach any other telegraph station in the world direct. However, a message to Bassidore or Lingah costs the Chicago sender $1.19 per word to Jask, Persia, and $11.76 extra for special dispatch boat line from that point.

Y. M. C. A. Electrical Club.

On March 15th an electrical club was organized in connection with the central department of the Chicago Young Men's Christian association. This organization is the outgrowth of the electrical classes in the Association College, and was formed to continue the work during the spring and summer. An interesting program of "Practical Talks" and excursions has been prepared for the next month. The date fixed for the first open meeting in the parlors of the association was Friday evening, April 23d, when J. Glen Wray of the Chicago Telephone company was secured to give a talk on the telephone.

The work of the two electrical classes during the winter has been of especial interest. The enrollment has been large and the average attendance has been over 80 per cent., which is a fine record for an evening school. The class in electrical practice visited the offices of the Postal Telegraph company, the Chicago Telephone company, the Board of Trade plant and the stations of the Chicago Edison company at Washington street and at Harrison street. A dynamo test was conducted by the students at the rooms of the Chicago School of Electricity and the members of the class assisted the instructor, George A. Damon, in a number of electric elevator and storage battery tests in connection with his regular work. In connection with the closing exercises of the association college a display of the apparatus used in both classes was made and created considerable interest. For the loan of much of this equipment the association is indebted to the kindness of Mr. Bagnall of the Chicago School of Electricity.

Minnesota Statesmanship.

[From the New York *Sun*.]

No historian, who wishes to be faithful to the task of recording the progress of the new economics and the new science of government among the law manufacturers, can afford to neglect the very interesting bill which is now before the Minnesota House of Representatives. This measure provides that City Councils shall have the right to fix, by a majority vote, the price of electric light gas and water. Of course, a city council which has once enjoyed the right of fixing the price of electric light, gas, and water, will find power so sweet that it will not rest content until it has the right to fix the price of every other commodity. If a Legislature once grants to a City Council the right to set a price on other people's property of a certain kind, it cannot logically refuse to grant the right to set a price on other kinds of property. The price of electric light is not of nearly as much importance to the community as the price of bread and milk and boots and shoes and clothes. The Common Councils will have to have the right to say at what price these and other necessities of life shall be sold. Obviously the lower the price, the more popular will be the Common Council and the more grateful their constituents. Luxuries will have to follow the fortunes of necessities. The price of everything will have to be determined by the state. This condition of things may be unpleasant for the butchers and bakers and candlestick makers in the Common Councils, but logic is logic; and when once you begin to confiscate, the confiscation is likely to become general. The Gopher philosopher who built the bill in question ought to have prepared a resolution to the effect that all property held by corporations ought to be taken from them without compensation. In a slightly modified form, the opinions of M. Proudhon seem to be accepted by a good many legislators.

X-rays and Spirit Manifestations.

When Professor Röntgen announced the discovery of the peculiar action of the X-ray and explained the manner in which this phenomenon might be produced, he had no idea of the numerous applications to which it would be put. Much amusement has been furnished by exhibitions of the application of X-rays and the revelations they have produced. But by far the most sensational event that has thus far been recorded was the startling "spirit manifestations" produced by X-rays in Paris recently, which is described by M. Henri de Parville in the *Journal des Debats* as follows:

The spectators were ushered into a parlor in which there was an abundance of vases and artistic glassware. In a corner there was an apparatus about as big as an ordinary magic lantern enveloped in black stuff. The guests numbered about 20.

The lights were extinguished just as in the case of a regular spirit seance. A sort of rattling was heard, and immediately afterward a gigantic and luminous hand passed over the heads of the assistants. Evidently it almost touched some of them, for we heard a little cry of terror that was quickly suppressed. "Don't be afraid," said the host, "it is not the hand of a ghost; I will show it to you in the light by and by." At the same moment a flock of luminous violins appeared and flew about in all directions. An old habitue of the boulevard remarked that we were with the Davenports. "Not at all," said the host, "there never was a ghost in this house." And the violins continued to dance over our heads. At last they disappeared as silently as they had come. Then an immense globe descended from the ceiling like a ball of phosphorous, oscillating like the peodulum of a clock. A luminous bell appeared in front of this globe and made regular bows to it. We could see its fiery tongue moving while the globe waltzed around.

Suddenly at the four corners of the room the glasses appeared to become ignited; the vases were illumined and the lustres sparkled. A table loaded with cups and glasses was lighted up. Everything seemed on fire. The whole room, that was so dark an instant before, was aflame on all sides with phosphorescent light of a soft and bluish color,

Then again all was darkness. Gradually a little light streamed in, and in a corner in front of a velvet portiere a human form appeared, at first vague and vaporous, hardly distinguishable. But soon its outlines became clear and it advanced. A lady beside me stepped back. Evidently she was not the only one, for we could hear the noise of moving chairs. The phantom advanced a few steps and then stopped. It was a tall woman. Her face had a greenish pallor; and what an extraordinary face it was. There were no eyes. We could only see two black holes under the eyelids. The mouth was closed; the hair was phosphorescent. A long, luminous veil enveloped this animated statue, and in the folds of the veil little sparks shone like diamonds. She raised her right arm slowly and tossed flames from her hand. There was no applause; all was hushed. The silent and severe apparition was watched with intense interest. A gong sounded. The apparation receded gently, and gradually faded out of sight.

Once more there was a noise of moving chairs, and we distinctly heard a sigh of relief. In the center of the room an immense and luminous bouquet next appeared with a blue band, upon which was written "X-rays."

Then the lights were turned on, and the parlor appeared in all its splendor. The host arose. "The seance is over," he said. "There was no spiritism about it, no occultism, nothing supernatural; it showed what X-rays can do, and that is all."

And now I can explain in substance that mysterious seance. It is well known that the Röntgen rays, invisible to our eys, render fluorescent substances phosphorescent, especially screens covered with cyanide of platinum. Recently a well-known maker of physical apparatus, M. Radiguet, found that under the action of X-rays all objects in glass and crystal shine with peculiar brilliancy, while everything else remains in complete obscurity. The machine that produces the rays is concealed behind several black cloths. Nobody can have any suspicion of its existence; but, nevertheless, the rays pass through all the cloths and light up all the glass objects, and nothing else, so that a glass held in the hand and moved up at will can be distinctly seen, while the hand is absolutely invisible. But glass is not the only thing that becomes phosphorescent at a distance behind the X-ray apparatus. The same effect is produced upon enamels, diamonds, porcelain, etc.

When M. Radiguet made this discovery he, of course, immediately said that it could produce sensational tricks, excite the public curiosity and create a new amusement destined to dethrone the ghosts.

The operator in the present case had only two assistants. They were sufficient to handle the objects and display all the marvels. Their task was simple; they had only to move them carefully. The operators could not be seen, but the glass violins, vases and the glass model of the hand were visible.

So much for the glasses. Now for the phantom. A figurante, tall and clever, was concealed behind some drapery and enveloped in a veil that was covered by a fluorescent substance. Her face was glazed with a phosphorescent sulphate of zinc powder. It is needless to say that the material could not be applied to the eyes, and that accounts for their absence in the livid face of the phantom.

It is estimated that an electric lighting plant proposed for Algona, Ia., would cost $5,000.

Electric Tramways at Argentina.[1]

The chief matter of electrical interest in this country just now is the commencement by La Compañia Tramways de la Capital to lay the rails which are to form the first electrical tramway in Argentina.

Although many people have applied for concessions to run electrically propelled cars in different parts of the city, up to the present no active work has been commenced, except by the company already mentioned. This company, which was floated in the United States, contemplates constructing an electric tramway some 26 miles in length, traversing some of the most important streets of the city, and forming a means of communication between the middle of the town and some of the more populous suburbs.

In the town proper, or at any rate in the more important streets, a conduit system, or insulated rail running along the side of the track, will be employed. In the outskirts of the town, however, and in the suburbs an overhead conductor will be used, no objection being made by the authorities to this method except in the center and more important parts of the city. The conduit and overhead conductor are to be supplied with current at a pressure of about 500 volts from feeding stations situated at regular intervals along the entire length of the line. These feeding stations are themselves to be connected to the generating station by rubber insulated armored cables drawn into an underground wood conduit having a round internal and a square external section. The use of armored cables for this purpose has been a good deal criticised, many engineers thinking that if any additional covering outside the vulcanized rubber was necessary lead should have been used on account of its superior lasting qualities, and also because the mechanical protection afforded by steel armoring is not required by a cable laid in the thick wooden conduit already referred to.

The drawing-in boxes for the feeder cables are to be situated about 110 meters apart, and are to be specially constructed after a North American design, the object aimed at being to insure an absolutely dry box. Arrangements are also made for ventilating the boxes by pipes led from them up the side of any adjacent building, thus reducing to a minimum the chance of gas accumulating in the box.

The work of laying the tramlines and feeder conduits is being pushed on with as much speed as possible, and it is hoped that by June this year some 16 miles of track will be completed, and that the erection of the machinery at the generating station will be sufficiently advanced to enable current to be supplied at that date.

As the metals themselves have to act as the return conductor, considerable attention is being paid to the joints between the rails, and in order to make these as electrically perfect as possible, a patent bond is being employed, which is said to make an entirely satisfactory and lasting metallic connection, and to have as low an electrical resistance as the rail itself.

The tramcars are to be of the double-deck pattern, designed to accommodate 52 passengers and propelled by two 25 horse power motors geared respectively to the axles of the two bogies carrying the frame of the car.

The generating station is well situated not far from the center of the district traversed by the tramway, and the plant itself consists of four water-tube boilers by the Stirling Water-tube Steam Boiler company, having a joint capacity of 950 effective horse power and a working pressure of 140 pounds per square inch.

The engines, of which there are three, are manufactured by Messrs. Ball & Wood of New Jersey, and are high speed vertical compound engines of 450 effective horse power, each direct-coupled to a 300 kilowatt continuous current dynamo manufactured by the Walker Manufacturing company of Ohio. These dynamos, which generate current at 500 volts pressure when on open circuit, are compounded to give 550 volts at their full working output of 550 amperes.

It is estimated that two of these dynamos will be sufficient to supply current to all the cars that will be running on the line at any one time, so that one complete set, *i. e.*, one dynamo and engine, will always be at rest, and can be used as a spare in the event of an accident happening to either of the other two sets.

Since the total boiler capacity of the station is only 950 horse power, it is inevitable that when two of these 450 horse power engines are working at full load all four boilers will be required, and there will be none left to use as a stand-by; it is not, however, contemplated that at first, at any rate, enough cars will be running to necessitate two engines being worked to their maximum output, and probably three of the boilers will be able to keep steam for the two engines working at normal load, which will allow of one boiler being unoccupied and being ready in case of a mishap occurring to any of the other three.

It will be observed that the whole of the orders for boilers, engines, dynamos, cars, cables, etc., indeed, for the whole plant for this tramway, have been placed in the United States, and although English firms have tendered for the supply of different portions of the machinery, they have not in any single instance been successful. This may no doubt be accounted for to some extent by the fact of the Tramway company itself being an American one, and by American engineers and manufacturers having had greater experience in traction work of all kinds than can be claimed by their rivals in England. It is, however, to be hoped that English manufacturers will supply, at all events, some of the material which will be required for the other electrical tramways which must inevitably follow the successful opening of this one.

1. From the Buenos Ayres correspondent of the London *Electrical Review*.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 17.—Rapid transit matters are simmering. The Rapid Transit Underground Railway company of this city has been incorporated and a bill to stop the work of the Rapid Transit commissioners has been introduced in the Assembly. The new company has a capital stock of $100,000, and is to operate an underground or tunnel road in the city of New York which shall extend partly through an open cut. The length of the road will be 10 miles. It will commence at a point near the City Hall Park and run northerly under various streets to Forty-second street and over the same to the Grand Central station, beyond this station to Broadway, and along Broadway to Fifty-ninth street; thence to the boulevard and Eleventh avenue, and along the same to 155th street. That portion of the route between 124th and 134th streets in Eleventh avenue is to be along the surface of the street. The company is said to be a company of engineers and contractors formed for the purpose of bidding for the contract for constructing the proposed underground road for the city. "We realize," said one, "that the work is too great to be undertaken by any one man, and are preparing ourselves to be in a position to secure a share of it. We have large capitalists behind us who cannot be mentioned now." Assemblyman McKnight of Queens county introduced the bill to suspend the operations of the Board of Rapid Transit commissioners of New York city until the Greater New York charter shall go into effect on January 1, 1898. This bill is said to be a notice on the part of Brooklyn that that city must be consulted in such an important improvement if Greater New York is to become an incorporate reality.

The New York & Harlem and the Metropolitan Street Railway companies have made an application to the State Railroad Commission for permission to use the trolley conduit system on several important lines in New York. The hearing on the matter will be given by the commission at the Chamber of Commerce, New York, on April 21st, at 11 A. M. The lines named in the application are: Park Row, between Broadway and Centre street; Centre street to Broome street; Broome and Grand streets to the Bowery; the Bowery to Fourth avenue; Fourth avenue to Forty-second steeet; Forty-second street to Madison avenue; also Vanderbilt avenue, from Forty-second to Forty-fourth street; Forty-fourth street to Madison avenue; Madison avenue, between Forty-second street and the Harlem River, and Astor place, between Fourth avenue and Broadway.

The municipal authorities appear to favor the scheme to acquire the Sixth and Eighth avenue railroads for the city. Mayor Strong has not yet given any direct expression of opinion in the matter. Corporation Counsel Scott, who, it is presumed, is acting with the mayor's acquiescence, sent a letter to Senator Raines urging him, as chairman of the Senate railroad committee, to secure the passage of a bill introduced on Wednesday by Senator Ford giving the city authority to purchase the railroads. Mr. Scott said that he hoped it was not too late in the session to secure the passage of proper legislation to give the city authority to raise funds necessary for the acquisition of the roads and to operate or lease them when so acquired. M. S.

Western New York.

BUFFALO, April 17.—The survey of the Penn Yan, Keuka Park & Branchport electric railroad is about completed. Work will be commenced on the road in a few days, and it is expected that it will be completed as far as Keuka College in July, and entirely finished before winter.

Negotiations are pending between M. D. Munger of the Canandaigua Electric Railroad company and the representatives of a Buffalo syndicate that wants to buy the plant. If the proposed sale is consummated the trolley line will be extended to the village of Manchester.

An electric railroad will soon be constructed from Lyons to Sodus Point. This scheme has been under the consideration of Wayne county farmers and merchants for several years. Electricians and engineers have already arrived at Lyons, and a company will be organized. One of the causes of the renewed interest in this project was the movement made a short time since by Rochester capitalists concerning the construction of a trolley line from that city to Sodus Point.

New York capitalists are constructing an electric railroad from Savona through the region of Lake Lamoka, in Yates county, to Lake Keuka. The road, which will cost about $200,000, will be known as the Lake Keuka & Savona railroad. The work of construction is under the supervision of J. D. Nares of Corning.

J. C. Rothery, president of the Niagara Falls (Ont.) Park electric railway, had a very narrow escape from serious injury recently. Mr. Rothery was on a car which was loaded with steel for the new suspension bridge. The car brooke loose from the motor car and began to run backward. Mr. Rothery made a rush for the brake, but lost his footing and fell on the track in front of the loaded car. By quick action and rare presence of mind he succeeded in getting out of the way of the wheels, escaping with only slight injuries.

The village of Youngstown has brought suit against the Frontier Electric railroad for using a portion of the public street with no authority in its franchise for doing so.

Articles of incorporation have been filed for the construction of an electric railroad, which will connect Buffalo with Wisdom, Big Tree, Hamburg, Orchard Park, Erie County Fair Grounds and East Aurora. The capital stock is $200,000. W. W. Wheatly of New York will be president for the first year; Arthur W. Hickman of Buffalo, vice-president; John A. Donaldson, attorney; Uriah J. Upson, treasurer; Ernest Wende, secretary. The construction of the road will begin the when frost leaves the ground. Heavy rails and a substantial roadbed will be a feature of the line. M.

Niagara Falls.

NIAGARA FALLS, N. Y., April 17.—It is indeed remarkable what a tendency to enlarge exists among the factories using electric power at Niagara Falls. Not only has the Pittsburg Reduction company enlarged its plant on the tunnel lands, but it has built a new factory on the property of the Niagara Falls Hydraulic Power & Manufacturing company. Very soon after the Carborundum company started business here the managers saw how much it was to their advantage to use Niagara power, and they built two kilns and now do all their work in this city. But in addition to this, this company has in contemplation the erection of more furnaces so as to about double the capacity. Furthermore, it will build a plant on the Canadian side to maintain their Canadian patents. The calcium carbide plant also feels the impulse of enlargement, and the company has erected a building fully as large as its original plant, and new furnaces and machinery are being added, which will greatly increase the product. The Niagara Electrochemical company has not been in operation many months, but, nevertheless, additions to the plant are being built. Then the Mathieson Alkali company had not finished its factory as at first planned before it announced that it would increase the orginal size in a considerable degree, which is now being done. The buildings of this plant cover more ground than any other factory using electric power on the Niagara Falls Power company's land. Far out beyond all these factories the Albright-Wilson Chemical company's plant is going up, building by building, and before many months will be in operation.

A bill recently introduced in the New York State Legislature is exciting considerable comment as to what the promoters of the project propose doing should they secure the rights asked for. On its face the bill incorporates the Columbia Electric Power company, the promoters of which are three men named Wild, residents of Columbia county. Further, the bill authorizes the formation of a company with a capital stock of $10,000,000, for the purpose, ostensibly, of damming Kinderhook creek, a small tributary of the Hudson river, and thereby generating electric power. One remarkable fact is that the company does not seek to be incorporated under the general incorporation act, and this is in part explained by the several peculiar features of the bill, one of which is that the bill gives permission to extend the lines of the company to all parts of the state, subject only to local ordinances in cities and towns, and another which allows the taking of additional power wherever and in whatever manner it may be necessary for the business of the company. The company would also have the right to take lands by condemnation proceedings. It is pointed out that under these broad provisions the Columbia Electric Power company could erect a plant at Niagara Falls to compete with the companies now located there, thus securing a franchise to do business at a point where the granting of further power rights is strongly opposed by the commissioners of the state reservation. Under such a franchise the company could also dam the Hudson, but the bill is being closely watched, and if it becomes law its provisions will likely undergo a great change.

Last year the entire peach crop of Niagara county was destroyed by the late frosts, and to prevent such a sad happening again some of the farmers propose a scheme that is interesting in its magnitude and design. It is well known that this loss of the peach crop would have been averted if the wind had been blowing slightly when the frost occurred. It is now proposed to organize a syndicate of farmers to buy an old water power at Newfane Station, and there erect a 50-foot dam to furnish power to generate electric current to operate huge fans to be erected by the peach growers throughout their orchards. On nights when the thermometer sinks to a certain point below zero these great fans would be set in motion, stirring air currents and thus saving the crop, which is worth many thousands of dollars, as Niagara county is one of the greatest fruit counties in New York state.

The Depew & Lancaster Light, Power & Conduit company has applied to the village trustees of Lancaster for permission to erect poles, string wires, etc., with a view of furnishing electricity throughout that village for lighting purposes. It is said that the company would receive its power from the Niagara Falls Power company. John N. Scatcherd of Buffalo is president of the company. O. E. D.

Northwestern Notations.

MINNEAPOLIS, April 17.—G. Van Ginkel, a Des Moines, Ia., capitalist, has arrived in Minneapolis with a project to construct an electric interurban line between Minneapolis and St. Paul and charge but a five-cent fare instead of 10 cents, as is charged by Mr. Lowry's line. He says that all he wants is a franchise, and he does not believe the present company would care to have its alleged exclusive franchises tested in the courts. He has had previous experience in the line of "bucking" the company already in the field, but the result would hardly set him down as an unqualified winner. In 1888, after a hot fight, he and his associates secured a franchise from the Des Moines City Council, granted on the ground that the old Council had exceeded its rights in giving the old company an exclusive franchise for an unreasonable term of years, and also that the old charter did not specify that the cars were to be operated by anything but horse power. Pending a settlement of the question by the Supreme Court, the Van Ginkel forces went ahead securing rights of way along streets not already occupied by the old company. Injunctions were airily ignored, and the new company, being unable to get rails fast enough, spiked common strap-iron down on the streets. Each company hustled to outwit the other. The Supreme Court decided against the action of the Council and the new company, and the old company then bought out its vanquished competitor.

The North American Telegraph company is preparing to move its head office in Minneapolis from 4 and 6 Washington avenue south to 16 and 18 Fourth street south. The change will be made about May 1st.

The lower house in the Minnesota Legislature has passed a bill making telegraph companies liable for damages to the extent of $400 for "mental anguish or suffering" caused by the non-delivery of messages.

The Pine Island, Minn., *Record* urges that steps be taken to secure an electric light plant for that village.

The Council of Eau Claire, Wis., is considering an ordinance granting a franchise to the Chippewa Valley Electric Railway company, which proposes to entirely rebuild the present street car line and make extensions, including one to Chippewa Falls.

Henry Duffield is interested in a project at Milton, Ia., to establish an electric light plant.

The citizens' note for $9,000 to secure money for a new engine for the electric light plant at Atlantic, Ia., in 1894 has been paid in full. The city has reached its bonded indebtedness limit and so 113 citizens signed a note to secure the necessary funds for the engine.

Contractors are figuring on rebuilding the Janesville, Wis., electric street car line, and it is said that the line will be in operation in two months.

Steps are being taken at Graceville, Minn., to establish an electric lighting plant, to be operated in connection with the city water works.

The city of Onalaska, Wis., has granted a franchise for electric lighting and power to the McMillan Mill & Power company of Neshonoc.

E. Buck, who has asked a franchise for electric lighting at Elroy, Wis., proposes a central electric light station at Union Center, Wis., from which he will furnish

light for the towns of Hillsboro, Wonewoc, Union Center and Elroy.

The projectors of the proposed electric line from La Crosse to Neillsville, Wis., are pushing it and a bonus is proposed by some of the towns interested.

The town of Goldfield, Iowa, voted down overwhelmingly the proposition to furnish light to that place from the plant at Eagle Grove.

Work has been begun at Morris, Minn., on the electric light plant of W. P. Fowler.

A Council committee of Grand Forks, N. D., will investigate the matter of lighting the city by electricity.

The route for the Waterloo & Cedar Falls, Iowa, electric railway has been decided upon after three surveys.

The Nashua, Iowa, electric light plant has been sold to George C. Hoyer.

The Massachusetts Loan & Trust company has brought suit against the Consolidated Street Railway company of Butte, Mont., to foreclose a $500,000 mortgage, due January 1st, because of default in the interest. The foreclosure was precipitated by an attempt to force collection of an old judgment of $17,000 held by E. E. Congdon, former superintendent of the company, the validity of which was disputed by the Loan & Trust company.

Because asked by the local manager of the Western Union Telegraph company at Mason City, Ia., if he would cancel the lease, Mr. Buchecker, the landlord, ordered the company to vacate by 8 P. M. of the same day, with the remark if the company did not he would move the stuff. He was warned not to touch anything, but, promptly on time, he forced an entrance and began pitching glass jars, instruments, tables, chairs, etc., out of the window. He was not interfered with, though officers stood watching him. The company had its workmen come and repair the damage and later Mr. Buchecker offered to refit the office with new furniture throughout. The matter will probably be settled amicably.

The Twin City Rapid Transit company has awarded the contract to furnish the cables to transmit the power from the new dam to the power houses in Minneapolis and St. Paul, to the National Underground Cable company of New York, and for the conduits to the National Conduit Manufacturing company of New York. The order comprises about 25 miles of each. The power dam is completed and all that remains is to install the water wheels and electrical machinery. The power will probably be available some time in June.

Forée Bain of Chicago replies to some of the criticisms passed upon his charges for tests of the electric equipment of the Hennepin county court house at Minneapolis, stating that he informed the county commissioners that he would charge $700 for the work, and they knew before he began the tests what the cost would be. He does not pose as a cheap man, he says.

The purchasers of the electric car line in Stillwater, Minn., have been taking down the wires. They started to tear up the ground wires, when the police interfered. There is an ordinance prohibiting anyone from tearing up the streets without permission, and it was under this ordinance that the work was stopped. The business men are behind the move, as they want the line operated. If the company persists in tearing up the line a bond must be given to assure the repairs to the streets and relaying the paving. This work will cost considerable, and it is hoped that the owners will conclude not to dismantle the system.

City Attorney Healy of Minneapolis has found that the electric companies of the city never accepted the franchise passed in 1889, which required the payment of a three per cent. tax, and so are still under the franchise of 1886, which requires no such unpleasant payments.

The contract for furnishing and installing an electric light plant for Rock Rapids, Ia., from plans by W. I. Gray of Minneapolis, was let to the Bigelow Electric Supply company of Lincoln, Neb., for $13,700.

The D. & D. Electric Manufacturing company of Minneapolis is negotiating with Mr. Madison of Chatfield, Minn., with a view to establishing an electric light plant jointly, using the Madison water power.

Quale & Swann contemplate establishing an electric light plant in Madison, Minn.

The Western Electric company of Chicago has secured the contract for furnishing the electric plant for the new Redwood Falls, Minn., plant.

The Minneapolis Street Railway company has tested a new electric motor, designed by W. Cooper, formerly master mechanic of the company, but now connected with an electric firm in the East. The motor was tested on an interburban car and was found satisfactory in the main.

Gardner & Walker will establish an electric light plant at Langdon, N. D. C.

PERSONAL.

Dr. G. H. B. Zahn of Dayton, Ohio, sailed for Europe last week. He will spend several weeks at Berlin before returning to this country.

Dan Hemingray—of course this is Mr. Daniel C. Hemingray of the Hemingray Glass company of Covington, Kentucky—was an esteemed Chicago visitor last week.

J. G. Ruhl, the secretary and treasurer of the Mitchell Tempered Copper company of Corry, Pa., has suffered a severe bereavement in the loss of his wife—a devoted companion for many years. His friends extend respectful sympathy.

The following-named out-of-town visitors in New York registered at the headquarters of the National Electric Light association, 136 Liberty street, last week: A. J. Simmons, Boston, Mass.; E. O. Wagmore, Dayton, O.; N. J. Mitchell, Philadelphia, Pa.; F. M. Law, Philadelphia, Pa.

The Electrical Bureau of the National Board of Fire Underwriters announces the addition to the field force of Theodore Varney, who is a graduate in electrical engineering of the Massachusetts Institute of Technology, and who has had several years' practical experience in different lines of electrical work.

L. E. McGann, who has been appointed commissioner of public works of Chicago by Mayor Harrison, was the moving spirit in the formation of the Chicago General Street Railway company, and became president of that corporation. Mr. McGann has had considerable experience in public life. Under the Cregier administration he occupied a responsible position in the public works department, and later served two terms in Congress.

Frank Stevens, superintendent of the Electric Protection company of 1428 Filbert street, Philadelphia, who has for several years been a councilman of that city, has recently been appointed upon the police and prison and electrical committees. The latter will probably have important work during the coming year, according to present indications. Mr. Stevens is a first-class electrician, and has been identified with the business for 20 years, starting with Prof. Edward Weston of the old United States company, in Newark.

The last appointment made by Mayor Swift of Chicago was that of John R. Bensley, to succeed Benjamin J. Rosenthal on the board of education. Mr. Bensley was formerly president of the board of trustees of the town of Hyde Park and served in that capacity for two years before it was annexed to Chicago. He is now president of the Hyde Park Electric Light & Power company of Chicago, and is an ex-president of the Board of Trade. He came to Chicago in 1853 from Erie county, New York, and lives at Ellis and Oakwood avenues.

Mrs. Robert C. Clowry, for 32 years the life-companion of Col. Clowry of Chicago, the vice-president and general manager of the Western Union Telegraph company, died in Lincoln, Neb., on April 18th. Mrs. Clowry was visiting in Lincoln with her mother, and was prostrated with what proved her fatal illness on Wednesday of last week. The funeral took place from her mother's residence in Omaha. Mrs. Clowry's maiden name was Caroline A. Estabrook. She was the only daughter of Experience Estabrook, who was at one time attorney-general of Wisconsin, and was born at Geneva Lake, Wis., October 23, 1845. She was a prominent member of the Woman's Club of Chicago, and was especially noted for her musical accomplishments. She was a sweet singer and a composer of note, some of her earlier productions achieving extraordinary popularity. Her death is a severe affliction to Col. Clowry, who is assured of the earnest sympathy of a multitude of friends at home and abroad.

ELECTRIC LIGHTING.

W. A. MacWilliams, Walter French and Cromwell Gibbons of St. Augustine, Fla., have applied to the City Council for a franchise for electric light plant.

The Garfield Electric Lighting company has secured the passage of an ordinance giving it a franchise to construct and maintain an electrical plant in the Twelfth ward, Chicago. The ordinance provides that all wires be placed underground and that the city shall have five per cent. of the gross receipts. At the end of 25 years the city can purchase the entire plant.

Observers at Ciege de Avila announce the arrival there of the electric plant which Captain-General Weyler ordered from the United States for the central or old trocha that runs from Jucaro to Moron. The troops, under General Arolas, have been stringing the wires. The object of the lights is, of course, to prevent the crossing of the trocha by the enemy at night.

Application has been made for a charter for the People's Electric Light company, with a capital stock of $100,000 and purpose of erecting and operating a plant to supply light and power in Columbia, S. C. The incorporators of the company are Aretas Blood of Manchester, N. H., Aretas Blood Carpenter of New Hampshire, and George Wallace Newton of Massachusetts.

ELECTRIC RAILWAYS.

Albert G. Wheeler, who is prominently identified with the Chicago General Electric railway enterprise, is reported to have said that the company will have a section of road ready for operation by December.

The Chicago City Railway company is cast-welding the joints in the tracks of its Forty-seventh street line. This line is six miles long and is the most important cross-town route in the company's network of lines on the South Side.

The Burlington, Iowa, street railway property has been sold at public auction to a syndicate of Boston capitalists, including Edwin G. McInnis and E. J. K. Noyes, Jr., for $50,000. It is stated by the new owners that they will expend $100,000 in improvements this season, including an extension of the line to West Burlington, three miles.

Enough money has been subscribed by the people of the vicinity of Myersville, Frederick county, Md., to build an electric road from that place to the top of South Mountain. Reno S. Harp, one of the promoters of the scheme to build an electric road from Hagerstown to Middletown, via Myersville, says that if the Frederick county people will not subscribe sufficient funds to build the road from Myersville to Middletown, at present the western terminus of the Frederick electric road, Hagerstown capital will be used to complete the project.

By a settlement of the difference between Receiver McKeon of the Illinois National Bank and Farson, Leach & Co., in relation to the Calumet Electric railroad securities, the bank is given title to all the bonds and stock of the road which it held as collateral, thereby securing practical ownership. Farson, Leach & Co. obtain an interest of 10 per cent. in the property and John Farson will continue to give his former attention to its affairs. Attorney Duncan said that the matter is practically settled. "The bank gets the railroad," he states, "and Farson, Leach & Co. are released from all liability."

The report of the operation of the Metropolitan Elevated railroad in the month of March, filed last week by Receiver Dickinson, makes a more favorable showing than the first statement. The average daily traffic last month was 47,811, and the gross earnings $76,408. Operating expenses amounted to 49.3 per cent. of the total income, making the net earnings for the month $38,759. On this basis the annual net earnings approximate $465,000, which is only $35,000 less than the full interest requirement. The Metropolitan road has been connected with the loop, and it is said that its cars will be run over the loop line in May. The officers of the Metropolitan "L" are confident that the traffic will be materially increased by the operation of the loop, probably to the extent of 20,000 passengers a day, which, it appears, would give the company an income sufficient to pay full interest on $10,000,000 of bonds and still leave a surplus of nearly $50,000, due allowance being made for the loop rental and estimating operating expenses at 50 per cent. The cash on hand at the end of the month was $97,878, an increase of $38,663, representing the net earnings for March above all expenditures. The first report, which covered the interval between the appointment of the receiver January 20th, and the close of February, showed an average daily traffic of 44,436.

TELEPHONE.

In the controversy over the telephone at Stoughton, Mass., J. D. Leatherbee made an interesting speech in which he referred to the progress of telephony in Stockholm, Sweden, showing the advantages to be derived from competition in this line. The Stockholm exchange has already been described in this journal.

The Western Telephone Construction company of Chicago recently scored another victory over the Bell company by its defeat of the Western Electric company in the suit brought by the Western Electric company against the Western Telephone Construction company for alleged infringement of the famous Roosevelt patent, No. 215,837. For many years back the Roosevelt patent has been considered the fundamental automatic telephone switch patent, and so broad and sweeping were its claims that it was supposed to cover every conceivable form of switches for changing from the calling to the talking circuits, and vice versa, by the mere act of taking the receiver from or replacing it on its point of support. So much faith did the Bell authorities have in the strength of this patent that they are said to have paid Roosevelt and his heirs a royalty of ten cents on every hook switch manufactured by that company during the life of the patent, and these royalties amounted in all to over $30,000. The devices used by the Western Telephone Construction company which were claimed by the complainants to infringe the Roosevelt patent were not only the old form of semi-manual switch, where the hook had to be pulled down after hanging the receiver upon it, but also on the automatic form of hook switch, similar to that which the company is now turning out, where the only movement necessary to operate it, is to remove the receiver from or replace it on the hook. Judge Grosscup, in his decision, refers to the previous art which disclosed means for cutting the telephone and call bell, alternately, in circuit, by means of a switch operated manually. This decision, although it does not now affect the general public directly (the patent having expired by natural limitation) is very

significant. It and the decision on the Watson switch hook patent, as handed down by Judge Showalter of the same court (WESTERN ELECTRICIAN, February 20, 1897,) show the attitude that the courts are quite likely to take in the consideration of the broad patents for auxiliary telephone apparatus owned by the Bell company; and they also show that the public has long been suffering needlessly at the hands of the great monopoly. The case was tried by Barton & Brown for the complainant and by Stanley S. Stout for the defendant. The judge held that the Roosevelt patent covered purely an automatic switch; one which acted without the volition of the operator, and that it did not cover any switch which required any manual operation at all, or required the removal or replacing of the telephone from its point of support.

MISCELLANEOUS.

Lehigh University's course in electrical engineering, under the direction of Dr. Alexander Macfarlane, is exceptionally complete. A pamphlet giving the schedule of the course and list of studies may be had by application to the authorities of the institution at South Bethlehem, Pa.

The Amsterdam, N. Y., Electric Light, Heat & Power company of Brooklyn was incorporated April 12th, with a capital of $500,000. The company will operate in Brooklyn and other places. The directors are Frank G. Writer, Edward J. Prest of New York city and Henry Heale of Brooklyn.

The Rose Polytechnic Institute of Terre Haute, Ind., has a well equipped department of electrical engineering in charge of Professors Gray, Wagner, Kendrick and Place. The fifteenth annual catalogue of the school, recently issued, gives an outline of the course of study and the plan of instruction.

The committee on science and the arts of the Franklin Institute of Philadelphia awarded the John Scott legacy premium and medal to Morris & Salom, representing the Electric Carriage & Wagon company, for the electrically-driven carriage developed by them. The Electric Carriage & Wagon company is now operating a number of these carriages in New York.

The Trenton & Mohawk Valley Power company of Utica, N. Y., was incorporated April 12th, with a capital of $500,000. The company is to generate and use electricity for producing light, heat and power. The directors are Angelo W. Myers, Richard A. Cunningham, Edward J. Slattery, William A. Chipman of New York city and William Pierrepont White of Utica.

The Supreme Court of the United States denied, on April 12th, the petition for a writ of certiorari in the case of the American Bell Telephone company against the Western Union Telegraph company, to compel the Circuit Court of Appeals for the first circuit to certify the case to the Supreme Court. The case involves the question of royalties claimed from the Bell company by the Western Union company, and was originally brought in the Circuit Court for the District of Massachusetts to secure an accounting of these royalties. It is understood that about $5,000,000 is involved. After instituting the suit the Western Union sought to have it dismissed, and after it was dismissed the Bell company appealed to the Circuit Court of Appeals, when the decision of the Circuit Court was reversed. The Western Union company sought to have the case reviewed by the Supreme Court, but the opinion now rendered denies this petition. This has the effect of taking the case back to the Circuit Court for further proceedings, in accordance with the decision of the Circuit Court of Appeals. The case is known as the "Stock Ticker" case.

On Saturday, April 17th, E. G. Acheson, president of the Carborundum company of Niagara Falls, and the discoverer of the new abrasive which has won such popularity, sailed for Germany to establish a plant for the manufacture of carborundum in that country. He was accompanied by James Hipple, who has been associated with Mr. Achesoo for several years, and is thoroughly familiar with the process of making carborundum. When he sailed Mr. Acheson expressed the opinion that they would be absent at least three months. It is expected that the plant in Germany will be about the size of the plant now in operation at Niagara Falls, which now consumes 1,000 horse power. The idea of erecting the plant in Germany is to protect the German patents, and Mr. Acheson could not say whether they would simply make the carborundum, or whether they would also manufacture wheels and the various other articles made from the abrasive, but he expressed the belief that they would sell the carborundum to others who would manufacture the several articles. The law in England is not so stringent, and it is to supply the English market, as well as the increasing American demand, that the Niagara Falls factory is to be enlarged. The Niagara Falls plant has been a great success, and on May 17th, or thereabouts, the Canadian plant will be in operation at Niagara Falls, Ont.

TRADE NEWS.

The Farr Telephone & Construction Supply company, 342 Dearborn street, Chicago, has just placed in the printer's hands what is said to be the most complete catalogue of telephones and telephone supplies ever issued. The catalogue will not only contain prices of telephones, etc., but it will include valuable and important information for those about to install telephone exchanges, and for linemen, construction men and others interested in telephony. The Farr company expects to be able to deliver these catalogues (free on request) about May 1st, and all who are interested should secure a copy.

The Chicago Fuse Wire Manufacturing company of 153 Lake street, Chicago, has been notified by J. W. Braid, chief of the department of electricity, that its fuse wire and links have been decided on for exclusive use in connection with the electric installation in the grounds and buildings of the Tennessee Centennial Exposition at Nashville. Mr. Braid says: "I find your goods very accurate and to be always uniform as to carrying capacity and fusing point."

E. Ward Wilkins of the Partrick & Carter company of Philadelphia completed in March the 25th year of his business connection with this old established house. There are but few men who have such a long record in the electrical business. The company has kept pace with the rapid growth of the electrical business, and today its large establishment is filled with everything that the average purchaser would inquire for, and there is nothing listed in its large catalogue that is not carried in stock; this secures for the purchaser a quick delivery of the goods. Mr. Wilkins has recently returned from an extended trip through the West, and reports that it is the equal, in results, of any which he has ever made.

The Northern Electrical Manufacturing company of Madison, Wis., has just opened Chicago headquarters at 1602 Monadnock block, Chicago. This office is in charge of A. W. Paine, a bright young engineer who has had several years' experience in this city, and is well and favorably known among electrical construction men. He is a hustler, not afraid of work, and will not misrepresent his goods for the purpose of making a sale. The business of the Northern Electrical Manufacturing company has, it is said, more than quadrupled within the last six months. The company is daily increasing shop forces and extending agencies. Its small, compact, invertible motors are becoming popular in machine shop practice, especially for direct-connected work. The Northern company has also recently perfected a line of direct-current generators up to 100 horse power.

The Missouri Telephone Manufacturing company of 917 Market street, St. Louis, has chosen J. D. Perry Lewis president. President Lewis is an experienced electrician, and one that the company believes to be thoroughly competent to fill the high office which he now holds in the concern. The business under the new management will be continued under the same lines as it has been heretofore. The Missouri Telephone Manufacturing company has always been looked upon as one of the rising telephone manufacturing interests not only in the West, but throughout this country. Starting in an exceedingly modest way, it has in a very short time built up a business that its originators can well be proud of. With Manager of Sales Coit, too, in charge of the disposition of the company's product, it is most reasonable to presume that the Missouri company will introduce its instruments into every state in the Union.

The Central Electric company, with its usual promptness in presenting information relative to good and seasonable devices, is out with its annual fan motor catalogue. It is a handsome little book, bound in olive green and an elegantly embossed cover, and presents "Cold Facts About Cooling Apparatus for Hot Weather." Without going into details relative to the various makes of apparatus listed, it may be said that the Central Electric company's experience in the handling of fan motors and ventilating devices enables it to select from the numerous makes and types such as possess the elements of economy and stability. It is perhaps needless to say that the Lundell apparatus is accorded a very prominent place in this book. This and other types of motors would seem to demonstrate the claim that the company "has motors of all kinds for all circuits." Those interested in fan motors should not be without this interesting piece of fan motor literature.

The Commercial Electric company of Indianapolis, Ind., which is so well known among the electrical trade as manufacturer of electric light and power machinery, has opened an office in Chicago, which is in charge of Frank L. Strong. Mr. Strong is well known in Chicago, having been engaged in the manufacture and installation of steam, refrigerating and electric power outfits for many years. He also has an excellent reputation in insurance circles throughout the country, having been selected by some of the leading companies to act as appraiser on many important occasions. This wide experience enables Mr. Strong to actively push the interests of the Commercial company, and as he has the reputation of being an exceptionally energetic man, it is confidently expected that the business of the Commercial company will be greatly increased in the section covered by the Chicago office. The company has made great strides in perfecting its system, and to-day it claims that its is without a peer. The Chicago office is located at 1202 Fisher building.

An important change in the electrical business has been brought about by the consolidation of the National Conduit & Cable company with the International Underground Cable company. The main office of the company is located in the Times building, New York. The consolidation was made advisable by the rapid increase in both branches of the business, which was under the control of men who held stock in each company. The National Conduit & Cable company is now the sole owner of the two former companies' patents for the manufacture of insulated wires and cables for telephone, telegraph, electric light and power service, and also for wrought iron cement-lined tubes for electric subways. It will make complete subway installations in any section of the United States. Because of the rapid growth of the business it has been found necessary to locate a factory in St. Louis. This plant will be ready for operation by May 1st, with a capacity of 20,000 feet of conduit per day, and the office will be at 620 Chestnut street. At a meeting recently held the following-named officers were elected: President, Edward S. Perot; vice-president, C. Gallagher; treasuer, James P. McQuaid; secretary, George J. Jackson. Mr. McQuaid will have the general management of the company's affairs, and, without question, past successes will be repeated. He reports that orders are already placed for 3,000,000 feet of conduit and over $500,000 worth of cable.

BUSINESS.

The Yale & Towne Manufacturing company, 84-86 Chambers street, New York, has issued a little circular descriptive of the Yale-Weston triplex chain pulley block. These pulley blocks are said to show a remarkable mechanical efficiency, and they are therefore recommended as being economical in time and labor.

General Manager N. B. Bubb of the Williamsport Wooden Pipe company of Williamsport, Pa., was a visitor to New York last week on business in connection with his conduit. Mr. Bubb reports that his company has been placing its large plant in condition to take care of an increased trade for the coming season by installing new machinery and apparatus.

The protection of electrical machinery from damage by electrical storms is always a serious matter to the central station manager at this season of the year. The Electric Appliance company is reminding the trade that it is still handling the reliable and time-tried swinging ball lightning arrester, thousands of which have been sold all over the United States during the last eight years.

"Application of Paints, Varnishes and Enamels for the Protection of Iron and Steel Structures and Hydraulic Work," is the title given to a handsomely illustrated volume issued by Edward Smith & Co., 45 Broadway, New York. It consists largely of papers read before engineers by Prof. A. H. Sabin, the firm's chemist, and many pictures of metal structures are given.

The new descriptive catalogue issued by the American Impulse Wheel company of 120 and 122 Liberty street, New York city, is an exhaustive description of the novel apparatus of the company, treating it from all points and in such a concise manner (profusely illustrated) that there is little doubt that anyone who may desire to consider this subject will receive useful information. This book can be had free upon application.

Users of rubber belting, valve disks, gaskets, hose, packing, etc., will find the new catalogue of the Peerless Rubber Manufacturing company of 16 Warren street, New York, of much value. It is claimed to be the most complete, in the line of mechanical rubber goods, ever offered to the trade. The frontispiece is a portrait of John H. Deming, general superintendent, "the inventor of 'Rainbow' packing, and the only man who ever has made or can make it."

The Western Electric company's fan motor has met with such success this season, and orders for it have been so large that it has been decided shortly to issue a new edition of the company's very neat catalogue, devoted exclusively to concise descriptive matter and prices relative to the Western Electric fan motor. In designing this fan motor special attention has been given to the following essential points: Cost, appearance, economy of operation and durability. The Western Electric fan motor catalogue should be in the hands of those intending to purchase the best the market affords.

The American Engine company of Bound Brook, N. J., seems to be enjoying a boom under the management of Frank H. Ball. Since the first of the year it has been found necessary to increase the capacity of the works, and now the company is installing a regular all-night working force, so that the establishment will run night and day hereafter. Among the recent shipments the following are mentioned: Cincinnati *Commercial Tribune*, 18 kilowatt dynamo; Cliff Paper company, 50 horse power motor and 25 horse power motor; Daily States Publishing company, 12 horse power motor; *Toledo Blade*, 12 horse power motor; *Cleveland Plain Dealer*, 25 kilowatt dynamo; *Bridgeport Post*, nine kilowatt dynamo; *Rochester Times*, 12 horse power motor; Daily and Weekly *News*, 25 horse power motor; *Baton Rouge Advocate*, five horse power motor; *Hartford Post*, 25 horse power motor; *Kansas Farmer*, 12 horse power motor; the Register company, 15 horse power motor; *Syracuse Standard*, nine kilowatt dynamo; the *St. Louis Star*, 50 horse power motor; Weaver Costello company, nine kilowatt dynamo; *Minneapolis Journal*, 14 by 12 American-Ball engine; Pennsylvania Silk company, 10 by 10 American-Ball engine.

The Chase Construction company of Detroit, Mich., has just been incorporated, with an authorized capital of $25,000. The company will devote itself to construction and equipment of central station lighting, electric railways, steam and water works plants. It has secured a contract to build the electric railway running between Cleveland and Lorain, Ohio, for the Lorain & Cleveland Electric Railroad company, which is to be completed by June 1st. The officers of the company are George E. Fisher, president and treasurer; O. D. Chase, secretary and chief of the engineering department, and E. N. Chase, vice-president and superintendent of

construction. The active men in the company are pioneers in the electrical business; O. D. Chase, whose name the company bears, was electrician and superintendent of the Commercial Electric Engineering company, and George E. Fisher was its business manager. During the term of the Commercial company's existence it installed 56 central station lighting plants and 167 isolated plants, in addition to a large volume of other electrical work. The Chase Construction company has secured the services of E. F. Mann as superintendent of railway construction, a practical man of large experience in railway work, having superintended the construction of the immense system of the Detroit Electric Railway company, Niagara Falls, Toronto and a number of the Cleveland roads, covering a period of 12 years. The company has handsome offices in the new Majestic building, in Detroit, and anticipates a very active business during the coming season.

The Gordon-Burnham Battery company of 82, 84 and 86 West Broadway, New York, has recently undergone an important change in its business affairs by the purchase of F. A. Burnham's interests by A. S. Pinkham, who will assume the general management of the company. Mr. Burnham has also resigned from the board of directors. Charles E. Lockwood has been elected secretary and treasurer. He has been permanently identified with the electrical business, being formerly with the Lord Electric company of Boston, Mass. W. C. Banks, who has been for several years electrician of this company, will still be connected with its interests, and is arranging at present for an extensive laboratory to carry on and develop several branches of work in connection with the Gordon-Burnham battery. A number of important features will be brought to the notice of the electrical trade in connection with this battery. L. C. Breyfogle has been appointed general sales agent, because of the resignation of R. C. Gordon, who will retain the office of vice-president of the company. General Manager Pinkham, although only connected for a little over a year with the Gordon-Burnham Battery company, is perhaps as well known in this line of business as anyone in the New York electrical trade, having had a large business experience as superintendent of the Standard Gas Lighting company, in charge of its Madison Square district, which is the largest one in New York city, and also in connection with the Lamson Consolidated Store Service company of Boston. This experience fits him for his new duties. He reports that the Department of Agriculture at Washington has recently sent requisition for 900 cells of No. 1 battery, together with 650 recharges.

President H. J. Medbery of the Fiberite company, Mechanicville, recently stated that his company had just gotten out a new line of overhead material in malleable iron fittings especially adapted for service on interurban high-speed roads. As is well known, this branch of the electric railway business is rapidly extending, and the Fiberite company recognises the importance of being first in the field, especially in the matter of "getting into line," so to speak, with what might be termed the steam railway trade. This line of material is made up of the regular Medbery insulation, but in malleable iron, and is outside of the regular line of Medberry aluminum bronze fittings. The Medberry insulation is a composition invented by H. J. Medbery after a long series of careful experiments. This chemical mixture is molded, while in a plastic state, under enormous hydraulic pressure into various shapes for electrical insulating purposes. The Chicago agency of the Fiberite company was placed not long ago in the hands of S. F. B. Morse & Co., with offices in the Marquette building, Chicago. With the agency in the hands of a man as well known as S. F. B. Morse the Fiberite company looks for an excellent trade throughout the West, especially during the coming season. The Medbery insulation is thoroughly well known, and the new line of Medbery malleable iron fittings should meet with ready demand. It is reported that during Mr. Medbery's stay in Chicago two very large contracts were closed by him. It is also of importance to state that the Fiberite company is in a position to manufacture any special devices that may be required. In addition to the regular line of Medbery material carried in Chicago by Western Agent S. F. B. Morse, a full line of Medbery switches can be found at all times.

ILLUSTRATED ELECTRICAL PATENT RECORD.

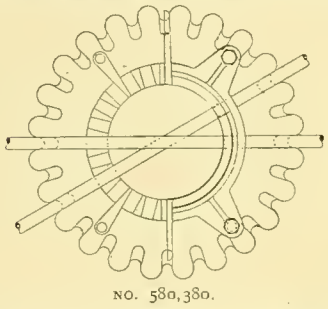
Issued April 13, 1897.

580,380. Supporting Means for Electric Railway Supply Conductors. Harry P. Davis, Pittsburg, Pa. Application filed June 10, 1896.

A support for crossover and branch conductors for electric railways, comprising a plate provided with a plurality of radial grooves, a cap-plate, and means for clamping the conductors between the plates.

580,381. Supporting Means for Electric Railway Supply Conductors. Harry P. Davis, Pittsburg, Pa. Application filed September 17, 1896.

A supporting device for electric railway conductors, consisting of a bar having a longitudinally grooved upper edge and a curved lower edge, and provided at one side substantially midway of its ends with a perforated ear, the perforation in the ear and the groove in the bar being in substantially the same horizontal plane.



NO. 580,380.

580,384. Electrical Indicating Wattmeter. Thomas Duncan, Fort Wayne, Ind. Application filed December 3, 1896.

In this wattmeter field coils are so arranged that their magnetic axis cross each other at right angles, and the magnetic axis of the diametric coils are out of alignment with each other, and also with the axis of the inclosed volt coil, and the vertically arranged volt coil is rigidly fixed upon a horizontal shaft within the field coils, and adapted to be actuated by the magnetic axis of the field coils.

580,428. Electrode for Secondary Batteries. Friedrich W. Schneider, Triberg, Germany. Application filed August 15, 1896.

Electrodes supported by frame consist of carriers having a perforated top and an imperforate bottom, and an open-top trough-shaped receptacle within the same supporting the active material.

580,434. Telephone Transmitter. Alfred Stromberg and Androv Carlson, Chicago, Ill. Application filed November 9, 1896.

In a telephone transmitter, the combination with a diaphragm of a sheet of wire gauze mounted upon the rear face thereof, a sheet of wire gauze mounted opposite the sheet of gauze upon the diaphragm, and granular carbon between the sheets of gauze.

580,451. Electro-depositing Device. James W. Conchar, Dubuque, Iowa. Application filed June 22, 1896.

The device consists of a tank containing a depositing bath, having anode connections, a supporting metallic bar above the bath, hooks to which the articles to be deposited upon are suspended within the bath from the supporting rod and bearing against the metallic bar, and a belt traveling below the supporting rod and adapted to engage the hooks, whereby the hooks are drawn along on the rod and with them the articles in the bath.

580,457. Electric Hoist. James A. Lounsbury, Chicago, Ill. Application filed July 13, 1896.

A motor frame of annular form having an integral extension or neck provides a bearing for a counter-shaft, and a terminal portion providing a bearing for a sheave shaft.

580,475. Electric Riveting Apparatus. Elihu Thomson, Lynn, Mass. Application filed June 14, 1889.

A transformer is employed whose secondary is a bar or rod, and a metallic anvil secured to and supported upon one terminal of the bar, and a metallic heading tool mounted opposite to the anvil upon the other terminal of the bar.

580,490. System of Constant Current Generation and Regulation. Thomas H. Hicks, Detroit, Mich. Application filed November 5, 1894.

One feature is a work-circuit having translating devices arranged in linear series, and a movable brush-holder provided with magnetic means for moving the brush-holder in one direction, the "magnetic means" including coils of wire, the same being connected in multiple arc with the work-circuit.

580,519. Circuit Controlling Apparatus. Francis M. Brinckerhoff, Matteawan, N. Y. Application filed March 10, 1896.

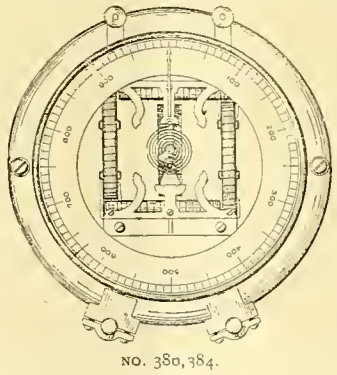
While a post at one end sustains the jaws a guide-post and a spring are employed tending to press the jaws together and cause them to press upon the knife.

580,523. Galvanic Battery. Ralph W. Gordon, Boston, Mass. Application filed October 1, 1894.

A negative element is secured to and dependent from the cover, and consists of a cylindrical receptacle having perforated walls; a depolarizing agent is contained in the receptacle; a positive element consists of an annular plate or cylinder of zinc surrounding the negative element, insulated suspending rods or wires for the positive element secured at their upper ends to the cover and extending downward therefrom between the elements, and provided with supporting portions at their lower ends for the positive element, and an insulated conductor is connected at its lower end with the negative element, and extends upward between the negative element and the positive element and through the cover of the jar, the conductor being provided with a binding-post for one terminal of the circuit, and one of the suspending rods being provided with a binding-post for the other terminal of the circuit.

580,557. Electric Headlight. Rennie P. Schwerin, San Francisco, Cal. Application filed September 30, 1896.

There is the combination of a parabolic casing having a top opening, a lamp socket fixed in the opening, a parabolic mirror within the casing and separated therefrom to form a ventilating space or channel, an incandescent lamp fitted to the socket and passing through an opening in the mirror, a flat-glazed front for the casing, an air-inlet into the bottom of the casing just in front of the lower edge of the mirror, an air-outlet between the upper portion of the mirror and the ventilating space, and an outlet from the space into the open air.



NO. 580,384.

580,584. Art of Insulating Electric Conductors. Archibald J. Robertson, Chicago, Ill. Application filed September 6, 1895.

The method of insulating electrical conductors consisting first in hermetically inclosing an electric conductor in a hollow conduit, and then exhausting and drying the air in conduit.

580,598. Electric Locomotive. William S. Elliott, Pittsburg, Pa. Application filed June 27, 1896.

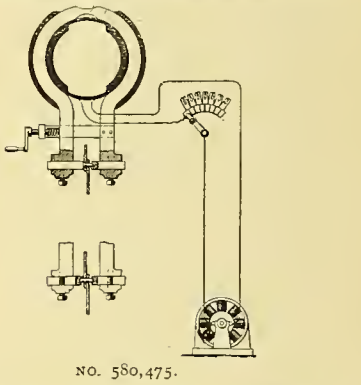
An upper motor and car-supporting framework are provided, and friction driving mechanism is supported upon the wheels; a lower framework is provided with housings, and car-axle boxes are mounted in the housings with means for adjusting the housings toward or from each other.

580,617. Printing Telegraph. Hermao Kreusler, Kreischerville, N. Y. Application filed March 6, 1896.

A telegraphic transmitter, comprising a swinging arm, a keyboard, a screw-shaft for swinging the arm, a local circuit controlled by the keyboard for controlling the arm, the keys of the keyboard being so located as to arrest the motion of the arm.

580,628. Insulator and Insulating Conduit or Tubing for Electrical Purposes. Frederick G. Treharne, Llanishen, England. Application filed October 28, 1896.

An electrical insulator consisting of silicates impregnated with electrically non-conducting cement.



NO. 580,475.

580,663. Means for Controlling Electric Currents. Edward Ellicott, Chicago, Ill. Application filed August 6, 1896.

Claim is made for the combination with a plurality of electrical circuits, of rheostatic controllers respectively connected therewith, each of the controllers consisting of a resistance adapted to be cut into and out of the respective circuit with which the device is connected, a cylinder, a piston moving therein connected with and controlling the resistance, and a valve provided with ports adapted to control the flow of an actuating fluid to and from the cylinder and admit the fluid to either side of the piston previous to permitting the flow thereof from the opposite side of the piston, an actuating fluid under pressure, and a main valve controlling the flow of the fluid to the several valves of the controlling devices.

580,678. Electric Switch. Thomas H. Brady, New Britain, Conn. Application filed January 9, 1897.

Four contact terminals, a central stem and mechanism for imparting movements of partial rotation to the stem are combined with an insulating disk mounted loosely on the stem and rotable therewith, and carrying two circuit closing plates in contact with the contact termioals.

580,734. Electric Arc Lamp. Albert C. Seibold, Mount Vernon, N. Y. Application filed May 11, 1892.

In an arc lamp, the combination of a transparent globe, flexible perforated disks closing the globe at top and bottom and encircling the carbons to form substantially air-tight closures, permitting a movement of the globe relative to the carbons, and means for adjusting the globe with the consumption of the carbons.

580,820. Electro-magnetic Locking Device. Egidius J. M. Scheeren, Denver, Colo. Application filed October 13, 1896.

An arm is pivoted on the casing and inclosed thereby, the arm being adapted to move into the path of the bolt-withdrawing device, yokes respectively attached to the arm extremities and carrying pole-pieces projecting beyond the lock-casing; two distinct electro-magnets are located in suitable proximity to these pole-pieces respectively; circuits normally open in which the magnets respectively lie, and suitable means, as push-buttons, for alternately and momentarily closing the circuits.

580,836. Electric Searchlight. Rudolph M. Hunter, Philadelphia, Pa. Application filed August 1, 1891.

A main frame, a reflector is connected to the main frame in a searchlight by means of springs, an arc lamp having its electrodes extending within the reflector, and mechanical devices for vibrating the reflector.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MAY 1, 1897. No. 18

Pile Driven into Cable Tunnel.

An incident in the construction of the power plant of the Union Elevated Railroad company of Chicago affords the subject of illustration on this page. The power house is now in course of construction at the head of Congress street on Market street. When excavations were made for the foundations it was found that the character of the soil would make it necessary to resort to piling. The piles were driven deeply, and one of them pierced the tunnel constructed under the Chicago River to carry the feeder cables of the Chicago Edison company from the Harrison street power house to the South Side. The pile was driven through the ceiling, which was a substantial brick structure, and protruded into the tunnel, but fortunately did not strike the cables. An examination revealed the fact that absolutely no damage was done excepting to the ceiling of the tunnel, as the pile was wedged in so tightly that there was no leakage. Accordingly, it was sawed off, and the bricks that had been disturbed replaced.

The illustration, which is a reproduction of a photograph taken immediately after the accident, graphically tells the story. The pile entered the tunnel only a few inches from the nearest cable and within a short distance of many more, as shown in the picture.

PILE DRIVEN INTO CABLE TUNNEL.

Postal Company Establishes Direct Connection with Mexico.

Contracts have been signed by the Postal Telegraph-cable company with the Mexican National and Mexican Central railroads for 25 years, giving the Postal company a strong foothold in Mexico and a large share in the business to and from that country. Heretofore, in sending messages from Mexico to points in the United States, it has been necessary to transmit them in a roundabout way. They were first sent to Vera Cruz, thence by cable to Galveston, and thence overland to their destination. Under the contracts signed on April 22d there will be direct overland telegraphic communication between points in Mexico and Postal Telegraph stations in the United States, including every important town and city in the country. Messages from Europe will pass by way of New York, over the lines of the Commercial Cable company, thus making a complete chain of communication between Mexico and Europe.

The telegraphic system controlled by the Mexican National and Mexican Central railroads comprises more than three thousand miles of wires, a network of communication covering the whole Republic of Mexico. Only one link in the chain is still wanting, and this will soon be supplied. Lines from San Antonio, Texas, to Laredo, Mexico, and from Albuquerque, N. M., to El Paso, Mexico, are being built, and when these are completed, which, it is expected, will be within a few months, the line from the Mexican capital to New York will be established. The Postal company is pushing its lines throughout Texas in every direction, and that state will shortly be covered as completely as the others in the Union.

The contracts are based upon mutual interest. The Postal has hitherto been without an inlet to Mexico. The railroads, on the other hand, while having lines from the capital to Laredo and El Paso, where they connect with the Western Union, have been practically shut out of participation in business to and from the United States, for the reason that the Western Union has insisted on all its telegrams going by way of the Vera Cruz-Galveston cable, refusing to accept messages from the termini of the railroads at Laredo and El Paso.

W. G. Raoul, who was instrumental in bringing about the deal, said:

"By the Western Union's refusal to allow business to go by the railroad lines to Laredo and El Paso, the railroads have been practically shut out. I cannot say that rates by way of Vera Cruz and Galveston have been excessive, and I believe the service has been good, but

naturally the Postal company wants business in Mexico, and naturally the railroad lines that were built for connection with the United States would like to participate. The new arrangement will be of great benefit to the commerce of both countries, because the immense mileage of the railroads will give it wider distribution."

Requirements of High Speed and Heavy Electric Traction.[1]

By Hayward Cochrane and E. J. Swartout.

In presenting this paper we have tried to bring out what seem to be some of the most practical conclusions of the best authorities, to condense these into practical form, and to suggest some outlines of what we consider to be the best results obtainable from the use of electrical machinery as it is now manufactured.

William Baxter, Jr., in a series of articles in the *Electrical Engineer* of 1896, gave data to prove that there would be a marked economy in coal consumption by the adoption of electric traction on roads now operated by steam. He showed that the cost of coal on trunk-line steam railroads was about 10 per cent. of the total operating expense; that the substitution of electricity would reduce this item to about 4½ per cent. of the operating expense. If such a saving as this could be effected on roads where the stops were few, a much greater saving ought to be made where the stops are frequent. Steam locomotives when starting trains are working at a very low economy, whereas an electric motor would consume energy more nearly in proportion to the work to be done.

O. T. Crosby ("Limits of Steam and Electricity in Transportation") states that the repair bill for electric railway motors would not exceed 30 per cent. of that for steam locomotives. Electricity would therefore effect a marked reduction in operating expenses over steam in repairs alone. The elevated roads in Chicago use motor cars equipped with two General Electric motors of 100 horse power nominal capacity and a drawbar pull of 2,000 pounds each at about 30 miles per hour with 33 inch driving wheels, or 2,700 pounds each at about 20 miles per hour. The series-parallel method of control is used. A few motor cars were equipped with four 100 horse power motors and were tested with two coaches, the loaded motor car weighing 70,000 pounds and each coach loaded 42,000 pounds, making a total train weight of 154,000 pounds or 77 tons. This train, we are informed, was run at a speed of 30 miles per hour on a level track. The weights of cars empty were as follows: Motor car, 60,000 pounds; coaches, 32,000 pounds. In case of the two-motor equipment, the motor car with two coaches, which is an ordinary train, gives a total train weight loaded of about 147,000 pounds or 73½ tons, assuming 10,000 pounds per car as full load and an empty motor car as weighing 53,000 pounds. With a maximum two-motor elevated train of one motor car and three coaches of 42,000 pounds loaded (which is a rush-hour train) we have a total train weight of 189,000 pounds or 94½ tons. We give in the table data regarding some of the standard makes of steam locomotives, also data of a B. & O. electric locomotive used in the tunnel at Baltimore, also data of the electric motor cars on the Metropolitan elevated railroad in Chicago. The approximate ratio of adhesive to tractive power is given, the adhesive power being calculated on a basis of 450 pounds per ton of weight on drivers, but the steam locomotives are supplied with sand boxes to use in case the wheels slip, which probably increases the adhesive power to 600 or 650 pounds per ton. The electric motor cars or locomotives should also have sand boxes, and these might be electrically operated.

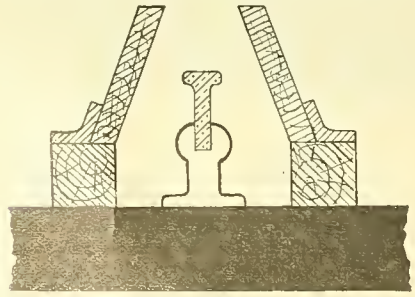


FIG. 1. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION

We will now estimate the tractive power and the adhesive power of the two-motor and four-motor equipments, in comparison with those of a Chicago, Rock Island & Pacific suburban steam locomotive.

Assume 12 coaches as the maximum train hauled by this locomotive and seven coaches as an average train,

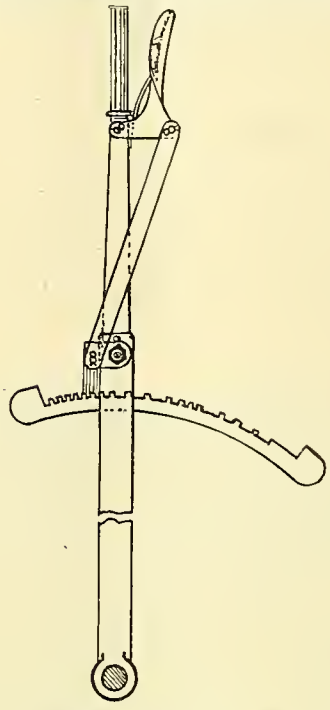


FIG. 3. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

and speeds of 30 miles per hour; total weight of engine and tender, 194,700 pounds; weight on drivers, 107,000 pounds; 12 coaches loaded at 58,400 pounds, 700,800 pounds; total train weight, 895,000 pounds, or 447¾ tons. With a seven-coach train at 58,400 pounds each the total is 408,800 pounds, plus engine and tender, 194,700 pounds, 603,500 pounds or 301¾ tons. The formula used by G. F. Wilson, superintendent of motive power for the Rock Island road, for obtaining the tractive power of locomotives, is:

$$T = \frac{D^2 \times P \times S}{W} \text{ pounds,}$$

where D is diameter of steam cylinders in inches; P is mean effective steam pressure, 85 per cent. of boiler pressure; S is length of stroke in inches; W is diameter of drivers. For the suburban engine, D=18 inches, P=(160×.85) 136, S=24 inches, W=63 75 inches. Substituting, we have

$$T = \frac{18^2 \times 136 \times 24}{63.75} = 16{,}588 \text{ pounds.}$$

Allowing 10 per cent. for friction losses, T=14,929 pounds. The adhesive power of the locomotive upon ordinary rails must greatly exceed the tractive power, because the rails may be wet or slippery at times. An English rule for obtaining the adhesive power of a locomotive is as follows: With dry rails, allow 600 pounds per ton of weight on drivers; with very wet rails, allow 550 pounds; with ordinary rails, 450 pounds; with misty weather, rails greasy, 300 pounds, and with rails frosty or snowy, 200 pounds. Assuming 450 pounds per ton, the suburban locomotive would have an adhesive power, A=107,000÷2,000×450=24,075 pounds, or about 61 per cent. greater than the tractive power.

Assuming that each loaded coach of a Chicago, Rock Island & Pacific suburban train weighs 58,400 pounds, and 12 coaches to be the largest train, the total train weight would be, including locomotive and tender, 895,000 pounds, or 447¾ tons. The tractive power being 14,929 pounds, there is a tractive power per ton of train of 33 3 pounds. For a seven-coach train weighing complete 301¾ tons, the tractive power per ton is 49.4 pounds. With an elevated railway train of two coaches and one motor car equipped with four motors, equal to a total weight of 77 tons, where the motor car loaded weighs 70,000 pounds, or 35 tons, the adhesive power is 35×450=15,700 pounds; but the tractive power of each motor at a speed of 20 miles per hour is about 2,700 pounds, or for four motors 10,800 pounds. The adhesive power is therefore about 45 per cent. above the tractive power, which is lower than for the Rock Island suburban engine. The tractive power per ton of train is 140 pounds, or greatly in excess of that for the Rock Island trains. For an elevated railway two-motor equipment, assuming a loaded motor car to weigh 63,000 pounds, with two loaded coaches each of 42,000 pounds, or a total train weight of 147,000 pounds, or 73½ tons, the tractive power would be that of two motors of 100 horse power each=2,700 pounds drawbar pull, or 5,400 pounds. Assuming the weight of motor car on drivers to be 35,000 pounds, we have the adhesive power equal to 35,000÷2,000×450=7,875 pounds, or about 45 per cent. more than the tractive power. The tractive power per ton of train is 73 4 pounds. For an elevated train of one motor car, loaded, equipped with two motors and three loaded coaches of 42,000 pounds each, the total train weight would be 189,000 pounds, or 94½ tons. The tractive power would be 5,400 pounds and the adhesive power 7,875 pounds. The tractive power per ton of train would be about 57 pounds, which is low for a service where the stops are so frequent. The adhesive and tractive power per ton of train should be much greater for frequent stopping than for a suburban service like that of the Rock Island road, where there are but four or five stops in eight miles. The motors used on suburban railways should be linked to both axles so that the whole weight of the motor car would be effective in giving adhesive power The motors, moreover, should be designed for a much greater weight per horse power, and since the trucks are crowded with them as they are now built, larger drivers, as well as slightly longer trucks, would probably be required. If the motors were designed with a greater weight per horse power, they would be less likely to heat seriously when run continuously under full load. It would be advisable, moreover, to have upon the motors a commutated field winding for use in connection with the series-parallel method of control, such that a greater number of safe and fairly economical running speeds could be had in place of the two running points of the present series-parallel controller. Running in series may give too slow a speed, while running in parallel may give too fast. If, however, the motorman can have the option of about six running speeds, it would be much easier for him to keep on schedule time. By having heavier motors per horse power and more running points, the acceleration and running of trains would be accomplished far more economically and satisfactorily than at present. The passenger coaches and trucks need not be any heavier than now built, and might be considerably lighter. The double spring suspension of motors should be adopted, as tending to prolong the life of rolling stock, and of rails not cast-welded

The third rail wherever used should be protected by guards so that trackmen would be comparatively safe while discharging their duties. Fig. 1 shows a form of trolley rail which we think would be better than the present form for using with high guards. This rail could be easily supported by insulating brackets at intervals and would be less likely to cause lodging of snow in winter. The top of the guards should be raised at least five inches above the top of the rail, and there should

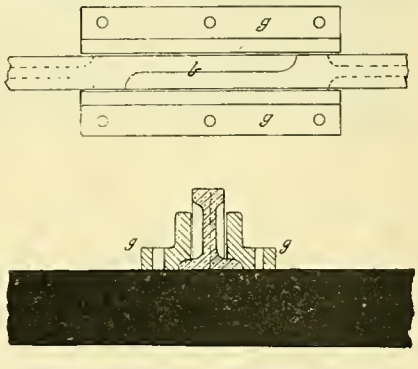


FIG. 2. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

NAME OF RAILROAD.	Total Wt. of Engine and Tender.	Weight of Engine.	Weight on Drivers.	Weight on Truck.	Weight of Tender Loaded.	Weight of Tender Empty.	Diameter of Drivers.	Size of Cylinder.	Steam Pressure.	Mean Effective Press. in Cylinder	Theo. Tractive Power.	10 per cent. off for Friction.	Ratio of Adhesive to Tractive Power Applied.	Dead Wt. per lb. of Tractive Power.	Type of Engine.	Class of Service.	H. P. of Electric Locom. of Same Wt. on Drivers.	App. Useful Wt. for Total Engine.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.			lbs.	lbs.	lbs.	lbs.						%
Chicago, Rock Island & Pacific	203,000	125,000	83,000	42,000	78,000	28,667	78"	19½"x26"	190	161½	20,470	18,423	1–1	4–1	8 Wheeler	Expre's	758	40
St. Clair Tunnel	195,000	195,000	195,000	.....	.....	.....	50"	22" x28"	160	136	36,861	33,175	1.2–1	.....	10 Wheeler	Tunnel	1,365	100
Chicago, Rock Island & Pacific	194,700	126,700	107,000	19,700	68,000	.....	63¾"	18" x24"	160	136	16,588	15,929	1.6–1	3–1	6 Coupled	Sub'b'n	614	54
Cleveland, Ciocinnati, Chicago & St. Louis. (Schen.)	216,000	126,000	83,000	43,000	90,000	40,000	72"	19" x24"	200	170	19,433	17,490	1–1	5–1	8 Wheeler	Expre's	719	38
Lake Shore & Michigan Southern. (Schen.)	205,133	118,000	90,000	28,000	87,133	40,800	68"	18" x24"	190	161½	18,468	16,621	1.25–1	4–1	10 Wheeler	Expre's	684	43
Baltimore & Ohio Tunnel	192,000	192,000	192,000	.....	.....	.....	62"	.. ..	...	.....	.....	38,880	1.1–1	.....	8 Wheeler	Tunnel	1,440	100
Burlington, Cedar Rapids & Northern. (Brooks)	221,000	137,000	108,000	29,000	84,000	37,667	69"	18" x26"	180	151	18,435	16,591	1.5–1	4–1	10 Wheeler	Tunnel	682	48
Chicago & Eastern Illinois (Schen.)	171,000	109,000	95,000	14,000	62,000	.....	63"	18" x24"	150	127½	15,737	14,163	1.5–1	3–1	6 Coupled	Sub'b'n	582	56
Chicago & Eastern Illinois (Schen.)	121,000	75,400	61,700	13,700	45,600	.....	57"	17" x24"	150	127½	15,514	13,963	1–1	2–1	4 Coupled	Sub'b'n	574	50
Vandalia (Pittsburg)	223,400	142,000	127,000	15,000	81,400	34,067	62"	20" x26"	185	157¼	26,393	23,754	1.2–1	2–1	.....Mogul.	.....	977	56
Metropolitan Elevated (Electric). Two motors	63,000	... .	35,000	.....	.....	.....	33"	....	....	.....	.....	5,400	1.4–1	5–1	.....	.....	200	55
Metropolitan Elevated (Electric). Four motors	70,000	.....	70,000	.....	.....	.....	33"	.....	....	.....	.....	10,800	1.4–1	.....	.....	.....	400	100

1. Read before the Chicago Electrical association, April 2, 1897.

be 2½ inches or more between the rail and either guard at the sides. For the sake of obtaining easy-riding trains and saving to rolling stock, it would be advisable to cast-weld the rails together and to have expansion joints (Fig. 2) at such intervals as might be found necessary to prevent too great a movement of rails at the joints. At the take-up joints *b* the rails could be specially designed, with each half equal in cross-section to the main cross-section of the standard form, there being no web, but the width at the top being retained down to the foot of the rail, with guides *g g* at the sides to keep the rails in place.

The motorman's cab should be arranged as follows: His seat should be from four to six feet back from the front window (this distance being easier for his eyes) and at the right-hand side of the cab. A sliding window should be placed by his seat to enable him to look out easily upon the track or the train whenever necessary. The painting of the cab should be dark so as to relieve the motorman's eyes from all glare. The controller should be operated by a horizontal lever (Fig. 3) instead of a crank, the lever being arranged with a dog engaging in notches which give the required speed combinations.

In Figs. 6 and 7 are shown a Pullman motor car, representing a leading type of such apparatus for high-speed work. It will be noticed that the windows are designed so as to make the car convertible to meet the requirements of the season.

The arrangement of partitions should be about as shown on the plan of Fig. 4 for suburban and small cross-country roads where the motor car is used for baggage, express, mail and smoker. For a road operated by direct current, it would be a nice arrangement to have the lights, and possibly the heaters, in each car fed from independent groups of storage cells. In case the train became stalled from failure of power circuit, the lights at least could be kept on for a considerable length of time, probably until the power circuit was put into working condition again. By charging batteries in series and connecting lights to groups at lower voltages there would be greater safety in controlling them and they would be less subject to flickering than in the case of present manner of connecting. By having skilled

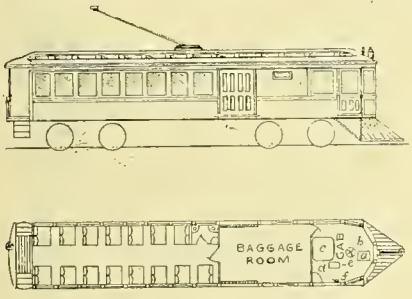


FIG. 4. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

motormen a saving in energy used to accelerate trains could be effected and the item of depreciation of rolling stock reduced to a minimum. The speeds attained by elevated and ordinary suburban trains is about 30 to 35 miles per hour maximum, which is doubtless high enough for frequent stopping. For express suburban service, however, considerably higher speeds, say of 40 to 45 miles per hour, might be advisable. For suburban service it would seem best to use elevated or partially elevated track in city limits, with no grade crossings, and a third-rail trolley, but for the suburbs to have the overhead trolley, since it would be impracticable to use the third rail where there were street crossings at grade. We are informed by the Walker Manufacturing company that one of its 32 ton motor cars, equipped with four 50 horse power motors, hauled six open coaches, each of 10 tons, at a speed of about 30 miles per hour, the total load upon the motor car and coaches being 670 persons. An ordinary trolley with No. 00 trolley wire was used and gave very satisfactory working. The total weight of empty motor car and coaches was 184,000 pounds, and assuming 150 pounds per passenger, the total load was 105,000 pounds, or a load per car of 15,000 pounds. The total train weight would therefore be 284,000 pounds or 142½ tons. Assuming a tractive power of 27 pounds per horse power of motors or 5,400 pounds for the four motors, the tractive power per ton of train was 37.8 pounds, or a little in excess of that for the largest Rock Island train, while the adhesive power was 14,400 pounds, or 166 per cent. of the tractive, or a trifle in excess of that for the Rock Island locomotive or the elevated railway motor cars.

For heavy suburban service, assume a train of five closed coaches hauled by a motor car equipped with 250 horse power nominal capacity, either four motors of 62½ horse power, one to each axle, or two motors of 125 horse power linked to pairs of axles, so as to obtain the full adhesive weight of the motor car, all its weight then being upon the drivers and therefore effective weight. If closed coaches of 32,000 pounds were used, five loaded coaches would weigh 210,000 pounds or 105 tons, but the six loaded coaches of the Walker train weighed 103 tons, assuming one-seventh of the total number of passengers to be in each coach. We may therefore assume for a heavy closed-car train of five coaches a motor car of about 35 tons or 70,000 pounds: this, plus a load of 10,000 pounds or five tons, makes a total train weight of 145 tons. Assuming an approximate tractive power of 27 pounds per horse power, gives 6,750 pounds as the tractive power of the suburban motor car. Assuming an average weight of motor car of 37 tons, we have an adhesive power of 15,650 pounds or 146 per cent. of the tractive power. With a direct current power system working at 500 or 600 volts pressure, say 600 volts (which would probably be best for any ordinary length of suburban road of about 15 miles, not over 20), a current of about 440 amperes would be required for the full rated capacity of the motors. On starting the train, a much larger current would be called for under ordinary conditions, a current which would be excessive for passing through such contact surface as would naturally obtain with the trolley wheel. To obviate this difficulty, we suggest the use of a trolley shoe substantially as shown in Fig. 5 (*a* and *b*),

FIG. 6. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

the shoe is shown separate at *c*. If this shoe were of metal, the trolley wire shown at *c* and *d* might have a soft steel shield rolled upon it to take the wear; or if the shoe were made of a mixture of plumbago and carbon, the plumbago would act as a lubricant and the ordinary hard drawn copper trolley wire could be used. The holder of the shoe can be made very light and provided with arms as shown at *a*, which are intended to extend only high enough at the sides to catch the trolley wire whenever by accident the shoe might leave it. The upward pressure of the shoe need be no greater than that now employed in the case of the trolley wheel. The shoe is designed to be about seven inches long and wide enough to follow any ordinary curvature in the trolley wire. The shoe holder is pivoted at right angles to the trolley wire and rests against a half-elliptical spring *s*, which allows the shoe to fit to the wire, while the angle which the trolley pole makes with the wire may vary considerably. The contact surface between the wire and the shoe is so much greater than with the trolley wheel that a much greater current can pass with no increase in sparking.

For short cross-country railroads of 30 to 60 miles length with light traffic, and for long trunk-line roads, it would seem almost out of the question to use the direct current system. The ideal for such lines would be the alternating current complete from generating station to car axle. At the present time, however, there seems to be no practical method of operating such a system. In order, therefore, to operate successfully such roads, taking into consideration the cost of installation and interest thereon, one of two lines of engineering should probably be proceeded upon. In either one the use of the alternating current at a pressure of 10,000 to 20,000 volts with step-up and step-down transformers for transmission from a central generating station to sub-stations at intervals along the line, for roads 30 to 100 miles long, would be used. One plan would be to place at each sub-station static and rotary transformers which would furnish direct current to sections of the road not over 15 miles long at a pressure of 500 to 700 volts and use a single trolley and rail-return circuit. The other plan would be to have the sub-stations further apart than in

FIG. 7. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

the former case and to install in each one a bank of static transformers which would deliver an alternating current of 1,000 to 2,000 volts to double or triple trolley wires of small cross-section; then to have upon each motor car or locomotive a rotary transformer of a capacity ample for any demand made upon the motors, which would receive direct current from it at 500 volts pressure. The efficiency of fully loaded static or rotary transformers is high, and is very good at medium loads. By using this system also, a special method of control might be employed. In connection with series motors, use the series-parallel commutated field method as previously herein suggested, and if greater ranges of speed were desired it might be practicable to vary the field strength of the generating side of the rotary transformer by means of a rheostat. The controller lever (Fig. 3) is shown as having a catch or dog which engages with notches in a quadrant. Looking from the pivot of the lever as shown, the narrow notches at the left are for varying the field strength of the rotary transformer when the motors are in plain series connection. The first wide notches are for making the changes in the commutations of the motor field windings, the motors still being in series. The set of narrow notches is for varying the field strength of the rotary transformer when the motors are connected in plain multiple. The second set of wide notches at the right is for making the changes in the commutations of the motor field windings, the motors being connected in multiple. In stopping the train the controller could be arranged so as to break the current over a large number of points simultaneously and instantaneously. By placing both static and rotary transformers in the sub-stations, the cost of copper for sub-feeders at 500 volts for a road of any considerable length would be enormous; besides there would be extra cost for attendance at sub-stations, and in considering such an outlay the probable business to be done by the road would have to be carefully estimated. For heavy trains and very high speeds, moreover, William Baxter, Jr., estimates that electric locomotives should have a maximum horse power of at least 1,250. This on a 500 volt circuit would call for more than 2,000 amperes and would necessitate an extremely heavy overhead construction if a trolley were used. If the third-rail system were used there should be no street crossings at grade, and in countries where snow falls there would be an endless amount of trouble at times with the third-rail on account of drifting. By placing the rotary transformers on the locomotives and having a pressure on the trolley lines of 1,000 to 2,000 volts, it would be necessary to insulate specially the conductors leading from the trolleys to rotary transformer from the frame of the locomotive, which fact would almost prohibit the use of the rails as one side of the circuit. The tripbase alternating system seems to be better suited to this class of work than the single or two-phase system, because it would save about 25 per cent. of the copper necessary for the former system. The trolley wires and feeders could be of comparatively small cross section, so that the overhead construction need not be extremely heavy, though it would of necessity be quite complicated. While the

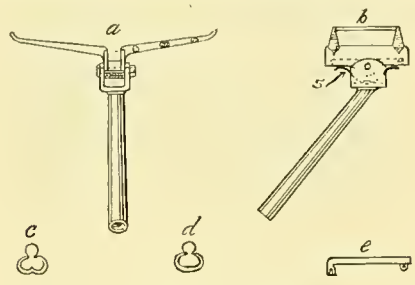


FIG. 5. REQUIREMENTS OF HIGH SPEED AND HEAVY ELECTRIC TRACTION.

double and triple trolley systems would have many objectionable features, yet they seem to offer at the present time about the best solution for the conducting system of long-distance electric traction. In planning the static transformer sub-stations it would be well to install at alternate stations a duplicate or relay transformer bank so that in case any working transformer bank became disabled it could be cut out and the relay cut in temporarily. The pole line should consist of iron pole construction and the erecting and spacing of distances should follow the plan of the best street railway installation, except that specially designed double insulating trolley wire hangers and feeder wire supports should be used. The locomotive should be provided with an electric brake as well as an air brake for very high speed service as an extra factor of safety; a brake similar to that of the Sperry design might be employed.

The arrangement of the locomotive cab for a combination baggage and smoking car is shown in plan view in Fig. 4. The rotary transformer *c* is shown slightly to the left of the center line of car and at the rear of the cab opposite the motorman's seat. His seat *d* is close by a sliding window similar to that of a steam locomotive. The controller *e* is at his left and slightly to the front and close to the rotary transformer. The air brake valve *f* is in front of the motorman and close to the side of car. The hand brake *b* is close to the controller at the front and left. The air pump *a* is in front and slightly to the right of center line of car, so as to counterbalance, with the weight of controller and rheostat frames, which are not shown, the position of the rotary transformer.

For heavy trunk-line work an independent locomotive should be used, in which case the rotary transformer should be placed at the middle and the air pump and rheostat frames disposed so as to counterbalance the weight of the controller, which could be at one side. By not using the rails for one side of the power system, an electric block signal system could be employed which would automatically stop a train in block No. 1 if block No. 2 were not clear.

Each train should be provided with a hand telephone, and the line supplied with a metallic circuit with branch blocks about eight to the mile, so that disabled trains could easily get assistance from the nearest station, using the batteries at that station for telephoning. Terminal facilities in large cities could be supplied by 500 volt direct current on the single trolley or third-rail system, and if tracks were partially or wholly elevated as they should be, this plan would work very nicely.

Electricity in Advertising.

The employment of electricity in advertising is considered by many large concerns in Chicago the most effective means of attracting attention to their establishments. This is especially true of those possessing advantageous locations upon the principal thoroughfares in the down-town retail district, where great attention is given to window dressing. On State street, for instance, between the river and Congress street, there is an almost bewildering display of electric signs, and the flood of light that is reflected from the show windows makes the street in front almost as light as day. But the use of electricity for advertising purposes is not confined to this comparatively small area, although it may be said that in the establishments in this district more current is used than in many good-sized towns. On many side streets and cross-town thoroughfares, particularly on West Madison street and North Clark street, small dealers make a point to have their stores brilliantly illuminated.

Of late there has been introduced an electrically illuminated revolving sign that bids fair to become an important factor in this line. It is expected that with the opening of the Union Loop for general use by the several elevated railway lines of the city an excellent field will be furnished for utilizing this novelty. Already a considerable demand has been made for an electric sign of this character, the first cost of which shall be reasonable and the expense of operation not so great as to prohibit its use by small shopkeepers. The accompanying cut illustrates a transparency designed by the Chicago Edison company to meet these special requirements. The construction is simple and the operation does not entail any labor or skill. The device consists of a cylinder, the frame and standards or brackets supporting it being of wood or metal and the body com-

ELECTRICITY IN ADVERTISING.

posed generally of colored glass, upon which the inscription or design intended to attract the eye is inscribed. Through the center of the cylinder runs a shaft upon which it revolves slowly. There are a number of panels which contain the signs, and these are brought into view one after the other. Inside of the cylinder, supported upon the shaft, is a reflector intended to throw the light from the 12 incandescent lamps which are employed upon each panel separately as the revolving of the sign brings each in succession before the reflector. The device is operated by a small motor, which is connected to the shaft or axis by a compound worm gear, which reduces the speed of the motor so that the axis turns at the rate of about three revolutions per minute. The sign has been used effectively for night display in windows which are not too well illuminated, and it also makes an attractive day-time sign. The cost is low compared with the cost of signs in which the letters are worked out in incandescent lamps, both for construction and for operation, particularly the latter.

Alabama Farmers Destroy Telephone Lines.

Until within a few months telephone lines have been unknown in Alabama outside of cities, but recently many towns have established telephonic connection. Some of the ignorant farmers had heard of this, but they could not understand how it was that a man in one place could speak to another 100 miles away. It so happened that about the time the long-distance telephone was run out of Huntsville, Ala., the price of cotton depreciated several points. The farmer is jealous of quotations of his cotton and being unable to account for the slump in any other way, laid it to the telephone. At first it was but a mere suggestion, but later it became the actual belief along the line built by the Georgia & Alabama company. So thoroughly imbued were they with this idea that they took the law into their own hands, and the courts have been appealed to by the corporation to protect its lines. On more than one occasion poles have been chopped down and wires cut into by farmers in their belief that they were responsible for the low price of cotton. One line in particular, extending from Gadsden to Walnut Grove, has been the victim of this belief at least half a dozen times. One farmer, after breaking the wire in two, tied one end to his wagon and pulled down seven miles of it.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The North Montana Telephone company has begun work on an extension of its line from Sun River to Augusta, Mont. When this is completed a line will be strung from Choteau to Dupuyer.

The Sheboygan Manitowoc County Telephone company of Sheboygan, Wis., will connect Manitowoc with St. Nazianz, School Hill, Louis Corners, Rockville, Millhome, Mission House College, Franklin, Rhine and Elkhart Lake.

The Twin City Telephone association has been formed in Minneapolis by the Western Electric Telephone company of Britt, Iowa, the Western Telephone Construction company of Chicago and the Mississippi Valley Telephone company of Keokuk, Iowa, to establish an exchange in the Twin Cities and to connect these various companies with the Twin Cities.

The Home Telephone company of Marshalltown, Iowa, has been sued by the Kaufman Telephone Construction company of Chicago for $11,000, the debt on a contract for $9,115.30 and interest. The officials of the Home company say that the contract price was paid and that the construction company had failed to carry out its contract completely.

The Des Moines, Iowa, Council instructed the board of public works to refuse permission to the Iowa Telephone company to string its wires until it obtains a renewal of its franchise.

Negotiations are pending between the Plainview Telephone company of Plainview, Minn., and the Werner & Dwelle company of Lake City, Minn., to connect their lines by way of Wabasha.

The Central Wisconsin Telephone company of Black River Falls, Wis., will construct a line from Black River Falls to Blair, via Taylor, Hixton, Alma Center and Merrillan.

The Iowa Telephone company has executed a mortgage for $750,000 to the Illinois Trust & Savings Bank of Chicago. This mortgage will be recorded in 98 counties of Iowa, in all of which the company holds franchises. It is understood that the money will be used to improve the system and enlarge it.

H. L. Savarien of New Ulm, Minn., and others propose to construct a telephone line to Mankato, Minn.

Geo. G. Candee is interested in the construction of a telephone line at Fertile, Minn. Work has been begun.

The American Telephone & Telegraph company has been granted a right of way through Lodi, Wis.

The E. H. Martin Telephone company of Webster City, Iowa, is extending a line to Iowa Falls.

There is considerable agitation at Iowa Falls, Iowa, for a telephone exchange.

A telephone line from Marshfield, Wis., to Rozellville, Wis., is being urged. The people of the latter place offer a bonus of $150.

A local telephone exchange is projected at Lake Mills, Iowa.

The Grant County Telephone company of Lancaster, Wis., will connect with Dubuque, Iowa, this season.

Telephony and Hypnotism.

[From the *Chicago Record.*]

Somebody has discovered a means of hypnotizing by telephone—a thing never dreamed of by the forefathers of the race. Newspaper accounts of the enterprise declare it to have been highly successful—as successful, indeed, as it was astounding. It is spoken of as the starting point of a new alliance of sciences, an alliance which will perform wonders. Well, perhaps it may, but, really, doesn't this seem to you to be carrying science just a little bit too far? If you can hypnotize by telephone, why not just as well pick pockets, or conduct a primary election, or cook a quick meal, or make a suit of clothes by ear-trumpet and transmitter? And, if it shall turn out that one can do these things, and the others which they suggest, will not this multiplied work have an ill effect upon the telephone service?

It is bad enough as it is to be told seven times in an hour that "Main 2345 is busy; please call again." But what will it be when the anxious caller is informed by the girl at Central that the telephone named is at the time engaged in the work of unloading a ton of hard coal, or mending a punctured bicycle tire, or something of that kind? On the whole, the more we look at it the more it appears that it is a mistake to impose any more work on the Chicago telephone. Anyone who wants to experiment in hypnotism can very easily attain his desire by paying a dollar and sitting in a stuffy parlor with a seventh daughter of a seventh daughter. Let the 'phone alone. Divorce this hypnotism alliance right away. Return the instrument to its normal function in mercantile life. There are limitations, and the use of a telephone for hypnotism or doing a week's washing is just beyond the first limitation.

Electric Power Transmission Project in the Mohawk Valley.

BY ORRIN E. DUNLAP.

In the incorporation of the Trenton & Mohawk Valley Power company of Utica, there is good promise that more money is to be expended in the development of the power resources of the Empire state. The Trenton & Mohawk Valley Power company has a capital of $500,000, and its object is to furnish electric light and power for the city of Utica and vicinity. The directors of the company are: Angelo W. Myers, Richard A. Cunningham, Edward J. Slattery and William A. Chapman of New York, and William Pierrepont White of Utica.

The power that this company expects to develop is that of the West Canada Creek at Trenton Falls. This creek has its source in the Adirondack mountains to the east of the villages of Trenton Falls and Prospect. Its course is westward, passing a little to the south of the village of Prospect, then making a turn nearly at a right angle, flowing south to the Mohawk river, of which it is the principal tributary, at Herkimer. A group of lakes, known as the West Canada lakes, about 40 miles northeast of Prospect, form the principal and most remote source of the stream. The facts that the forests surrounding the source of water supply are assured of preservation and the locality about the points of proposed development offers good markets for the sale of the power product of the company are an encouraging incen-

ELECTRIC POWER TRANSMISSION PROJECT IN THE MOHAWK VALLEY.

tive to the investment of capital in the enterprise. New York state stands as a guardian over the Adirondack forests, and the watershed of the proposed source of power is of the highest portion of the Adirondack wilderness. This watershed is about 175 miles square, and has more than 60 lakes, having a total area of 12 square miles. The elevation of the lowest of the lakes is about 2,300 feet above the sea level, while the lowest portion of the watershed is about 750 feet above the streets of Utica. In its course, as it flows from these lakes for a distance of 40 miles, the West Canada creek receives additional water through various tributaries. Near the village of Prospect the creek takes a sharp turn and flows nearly south for a distance of 2½ miles, and on this part of its course it has a fall of about 500 feet. From a point known as Morgan's Mill there is a further fall of about 250 feet, distributed along its course to the Mohawk.

Some months ago Wallace C. Johnson of Niagara Falls, who is thoroughly well posted on the subject of power development, made an extended report to several Utica men on the proposed power project, and in which he recited many advantageous facts. It is probable that the development of the company just organized will be on more extended lines than at first contemplated, and that a higher head of water will be found available. The power company owns the land on both sides of the river at Trenton Falls, and it expects to be able to generate power without the aid of storage reservoirs. The scenery about the Falls is very romantic, and the idea of basing an industrial boom in the pretty locality arouses a feeling similar to what the Niagara development did to the State Reservation, but when the power plant is established it will no doubt be found as welcome as the great

Niagara plants are to-day, and the beauty of the spot will remain unmarred.

A project very similar to that here outlined is in progress of development at High Falls, on the East Canada Creek, at Dolgeville, where Alfred Dolge has awarded the contract for the necessary plant to develop 3,000 horse power, a portion of which will be electrically transmitted to Little Falls.

Cause of Fire at Union Traction Company's Power House, Philadelphia.

The investigation of the cause of the fire at the power house of the Union Traction company of Philadelphia on March 3d is the subject of a report by William McDevitt to the Philadelphia Fire Underwriters' association, which is presented in the last quarterly fire report of the Electrical Bureau of the National Board of Fire Underwriters:

The fire occurred about 6 P. M., while a number of employes were present and the plant in full operation. During the progress of the fire inquiries as to its cause were made of some of the employes, who stated that they had heard that the fire was caused by a hoisting chain. Early the next morning your inspector visited the ruins and found a chain from an overhead crane hanging in close proximity to one of the generators. Upon examining the chain a number of links bore evidence of an electric burn and fusing, as also did an exposed electrical attachment of the generator, proving that an electrical contact had been formed in some way between the chain and the generator. This unmistakable evidence, however, was disputed by some person not familiar with such matters, while those who witnessed the accident were reluctant to give any information.

Having been furnished by the officers of the Union Traction company with authority to get all information desired, your inspector was enabled to confirm the theory he already held by the statement of William Ross, an oiler, who said that at the time of the accident he was standing near one of the generators, and that a hoisting chain, which was held back by resting on a guard rail, was drawn from its position by a moving of the crane by employes at the other end of the room. This caused the chain to swing down against the fly-wheel of the engine, from which it rebounded and struck against one of the lead heads to which the conductors were attached on the generator, causing a violent flash. Another employe grasped the dangling chain with his hand, but finding it too hot, took his hat, and securing the chain prevented it from doing further damage. The swinging contact (the chain being grounded) produced a short circuit for an instant, but the machine resumed its normal speed intact until the engine was stopped. In the meantime molten metal had been spattered down into the flywheel pit, setting fire to a board partition at that point, and at the same time igniting the insulation on the conductors. Every effort was used to extinguish the fire, but owing to the dense smoke the attempt was unsuccessful. Upon the arrival of the firemen the same obstacle was met, preventing access to the cellar, where the fire at that time was confined.

The premises were divided into three buildings, separated by brick walls; the main portion, containing the machinery, being a one-story and basement building with a floor area of 149 by 98 feet; the boiler house being one-story high with a ground area of 170 by 81 feet, and the office building three stories high, located at one end of the machinery building. The roofs of the main building, the office portion and also that of the boiler house, were of wood covered with slag, and were constructed on the valley form, rising from the side walls of each building with a battlement to a peak in the center, with monitor skylight on each and supported by iron trusses. The floor, which was of plank covered with flooring boards, was badly burned about the center of machinery room, but nearly all that portion of it along the side walls, including that under the switchboard, was left in good condition. The fire destroyed the entire roofs of all buildings, and, with one exception, all the generators and engines and switchboard apparatus. (One of the large generators and engines sustaining a water damage only is now undergoing a drying-out process.) The boiler house sustained but little damage beyond the destruction of the roof, the boilers being left in good condition.

Considerable inquiry and comment has been made as to how the interior of the roof became ignited, being at a height of 40 feet from the floor, without any conductor to carry fire upward. This feature, it seems to your inspector, can perhaps be accounted for by the already heated condition of the room, caused by radiation from the immense steam pipes traversing the cellar and first floor, which necessitated enclosing the open space around the machines in the cellar with board partitions to keep out the excessive heat—a bad feature. The fire started on the floor at a point within three feet of the east wall, immediately under the square of the roof, and as the floors and other wood-work were oil soaked, the heat ascending was sufficient to ignite the roof at its lowest point and follow its gradual elevation.

One of the most surprising features observed during the fire was the rapid collapse of the iron roof trusses. These fell in twisted form in a comparatively short time after the fire had started, and before the roof was half burned away, and in their descent caused considerable wreckage of pipes and machinery, also letting the burning roof down, thus adding more fire to that partly extinguished at the floor.

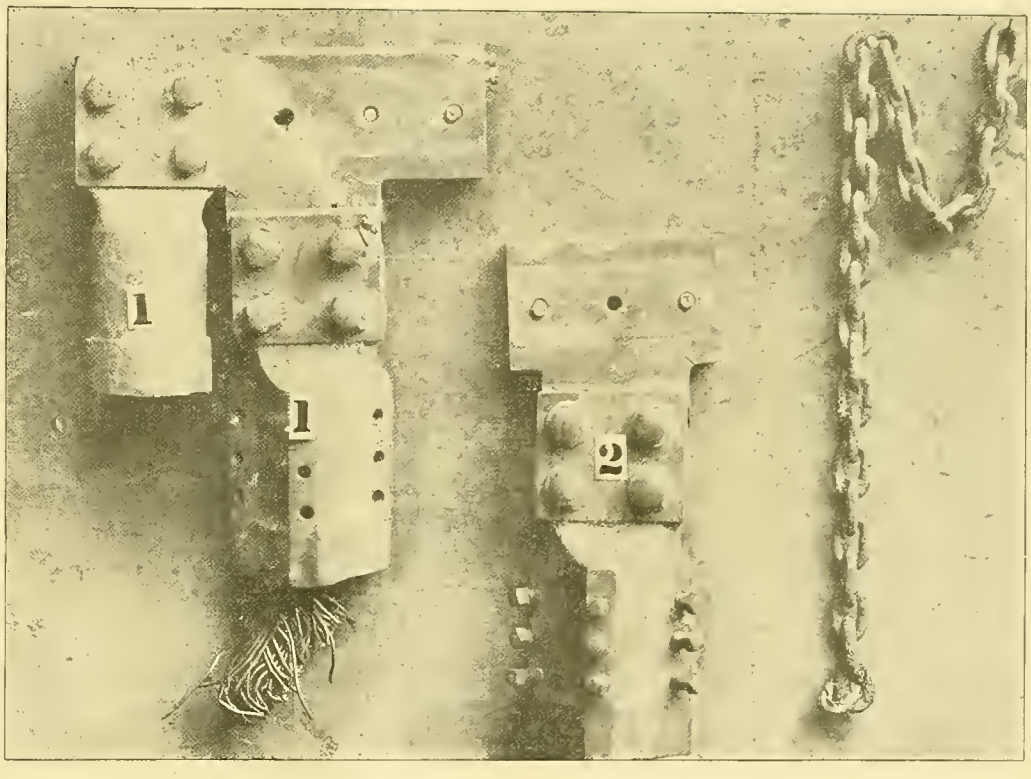
The primary cause of this fire, from a grounded hoisting chain causing a foreign contact, may be classed as an accident, but the occurrence of a similar accident (without causing fire) at another establishment of like character, should serve as a lesson to be observed in the future management of all such risks.

The accompanying picture, which was furnished by the electrical bureau, shows the fusing of the lower links of the chain and bolt heads on the generator leads.

American Institute of Electrical Engineers.

At the 115th meeting of the Institute, held at New York on April 21st, a paper was read by Dr. A. C. Crehore and Lieut. G. O. Squier on "The Synchronograph—A New Method of Rapidly Transmitting Intelligence by the Alternating Current." On account of the length of the paper and the time occupied in its illustration by lantern slides, the discussion was postponed until the annual meeting, May 18th.

The same paper was read by Dr. Bedell before the western members at a meeting held at Armour Institute of Technology, Chicago. The meeting was well attended and was presided over by A. V. Abbott. Prof. Stine and several others participated in the discussion.



CAUSE OF FIRE AT UNION TRACTION COMPANY'S POWER HOUSE, PHILADELPHIA.

The New Telephone Girl.

[From *Harper's Bazaar.*]

She was a new girl at the central telephone exchange. Her previous experience in this big and busy world had been behind the counter at Chintz & Chally's. Nevertheless, she was a pleasant-spoken young lady and amiability was written all over her nature. She had adopted as her motto the touching sentence: "We strive to please," and she honestly tried to live up to it. There was a ring at the bell. She applied her ear to the instrument and and asked, sweetly:

"What number, please?"

"Let me have No. 474."

"I am sorry that No. 474 is busy now," she replied. "You can have No. 473 or No. 475 if you wish."

The individual at the other end of the wire hung up his receiver and used language which plainly showed that all efforts to please do not necessarily succeed.

B. C. Keeley is putting in an electric light plant at Randolph, Wis.

The Telephone in Law.

A correspondent of the New York *Sun* recalls an interesting circumstance in support of the admission of telephone messages as legal evidence:

The first instance of such admission was in no less famous a case than that of Ferdinand Ward, of Grant & Ward. This was in October, 1885. On October 26th James D. Fish, then serving 10 years in Sing Sing for wrecking the Marine National Bank, of which he had been president, took the stand against Ward, and swore that he had talked to Ward over a private telephone running from the bank to Grant & Ward's private office, and that Ward had instructed him what to do with two checks, one for $71,800 on the Marine National Bank, and one for $75,000 on the First National Bank. He swore positively that Ward was the person with whom he had had the conversation.

Benjamin F. Tracy and Bourke Cockran, lawyers for Ward, protested against this testimony, declaring that it was incompetent. Justice Barrett, trial judge, decided against them, however, and admitted the telephone conversation as evidence.

On the following day, October 27th, Benjamin Fish, a brother of the preceding witness, swore he had been standing with his head within 18 inches of the telephone at the time his brother and Ward had talked about the checks, and that he heard Ward's voice distinctly come over the telephone, although his brother had the receiver to his ear. The lawyers for the defense declared that such a statement was ridiculous, but the prosecution showed a letter that Ward had written Fish, complaining about the fact that everyone in the room where that telephone was could hear what was being said.

Ward was found guilty and was sentenced to 10 years at Sing Sing. On appeal Justice Barrett's decision admitting the telephone message was sustained.

Damages for Failure to Deliver Copper.

A very important case in the Supreme Court of the state of New York, brought by the Okonite company of New York city against Holmes, Booth & Haydens, was discontinued last week. Much interest had been shown in the proceeding. The complaint set forth that in June, 1895, Holmes, Booth & Haydens sold to the Okonite company 300,000 pounds of copper at 12¼ cents per pound, and after having delivered 50,509 pounds refused to further comply with the terms of the contract. The Okonite company, in September, 1895, was obliged to purchase its supply of copper elsewhere in the open market at a price of 14 cents per pound, and at that time began suit against the defendants for the sum of $4,500, representing the difference between the contract price and that for which the copper was purchased. The defense denied the contract, and an order discontinuing the suit was entered on April 21st. It is reported that Holmes, Booth & Haydens have paid the Okonite company about $2,800 in settlement of this difference.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 16,630.

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In support of the statement that the introduction of the electric railway has effected a radical change in methods and manners, in conditions and requirements, the experience of the city of Washington may be cited. The people take advantage of the improved transportation facilities to get away from the business district and establish their homes in the outskirts where they can have better air and better surroundings. The police recently took a census of the District of Columbia, and the compiled figures show that the city of Washington has lost in population, while the suburban portion of the District has gained considerably since 1895, when the last police census was taken. According to the figures obtained, the District has a population of 277,483. The average gain heretofore has been about 10,000 every two years, but for the period between 1895 and 1897 it has been only half that. While some of the city police precincts have increased their number of inhabitants, there are fewer people now residing in the business sections and those occupied largely by department clerks, than there were two years ago.

When Mr. Hering, in his "Digest" of current electrical literature, refers to Mr. Arnold's series of articles in the WESTERN ELECTRICIAN as a "reprint" of the lectures delivered by the author at the University of Nebraska, he is either ignorant of the meaning of the word he employs or is deliberately striving to create a false impression. A reprint is "a second or a new impression or edition of any printed work." That does not apply to the Arnold lectures. Moreover, considerable new material is embodied in the articles appearing in the WESTERN ELECTRICIAN.

Announcement of the successful termination of negotiations for the extension of the lines of the Postal Telegraph cable company, comes from New York this week. This should prove a valuable acquisition to the Postal system, especially in view of the growing importance of the commercial relations between this country and our sister republic. The enterprise shown by the Mexican railroads in this connection is encouraging and indicates the eagerness with which every opportunity to improve trade relations with the United States is grasped by the men in control of the financial and commercial affairs of Mexico.

Much speculation has been indulged in by those who are interested in the outcome of the government suit against the American Bell Telephone company to cancel the Berliner patent. Should the decision of the court be in favor of the telephone company, it is said that it will at once enter actively into the telegraph field, while, according to the same authority, the Western Union company will be shut out from the telephone field. The issue of the case is in some doubt, judging from its course in the courts below, but those who imagine that a decision in favor of the telephone company will give the Bell interests a monopoly of the field of telephony are greatly mistaken. It is safe to say that the day of telephone monopoly in this country has passed and that henceforth the Bell companies will have to content themselves with what business they can get on merit.

A curious condition of affairs at Lafayette, Ind., is brought to our notice by a correspondent who calls attention to an ordinance passed by the Town Council requiring a construction company to furnish a bond for $1,000 before undertaking the installation of electric bells in that town. The bond is to insure good work, the use of good material and "conduits" in wiring for electric doorbells and similar work, and furthermore to guarantee the community against loss of life or damage to property through these installations. Such regulations and restrictions as those mentioned by our correspondent are, of course, absurd, and it is not to be wondered that the presumption of the town board of Lafayette is a subject of ridicule and excites contempt. It requires no fine sense of humor to appreciate the absurdity of the provision for the safety of the community against the deadly effect of a current from a Laclanche cell or a carbon battery, especially in view of the amount of the bond required.

But there is a serious aspect to this subject which must appear to all who are engaged in similar work. It shows how meddlesome officials can make considerable trouble for legitimate companies without increasing the efficiency of the work. In this particular case there seems to be no more reason why the contractors mentioned should be required to give a bond than that steamfitters or plumbers should be obliged to make provision guaranteeing the community against the bursting of water pipes or the explosion of a boiler. The ordinance is an example of paternalism that, like many other regulations of its kind, is amusing to the general public, but very annoying to those whom it directly affects.

The movement having for its object the establishment of a reduced rate of fare for street railway service received a serious setback at Indianapolis last week, when Judge Showalter of the United States Circuit Court decided that the three-cent fare bill passed recently by the Legislature of Indiana was invalid, because it was special legislation, applying only to the street railway company of Indianapolis, and because it was in violation of the contract created by the franchises under which the company operated.

In the opinion the court holds that the charter cannot, under the constitution of Indiana, be amended by any enactment which is special to any particular street railroad corporation or to any particular community or locality in Indiana; that the amendment of 1897 is confined in its operation to the city of Indianapolis and to the Citizens' Street Railroad company, and to other street railroad corporations now or to be hereafter organized for carrying passengers over the streets of that city; that if the scheme as proposed in the amendment be carried into effect complainant, which is mortgagee of the railroad property of the defendant corporation in Indianapolis to the extent of some $3,000,000 of bonds, will be irremediably injured in its security; that by the amendment of 1897 the state of Indiana would violate its engagement to the defendant railroad company as expressed in the general law for the incorporation of street railroad companies, and this in contravention of the national constitution, which declares that no state shall pass any "law impairing the obligation of contracts." On this latter ground, as well as by reason of the non-residence of the complainant, the controversy, it is said, falls within the judicial power of the United States. Accordingly, injunctions have issued restraining the enforcement of the law.

The decision is a complete victory for the street railway interests, and is of special importance, as it establishes a precedent for the settlement of many disputed points. The result of the decision must have a good effect in restoring confidence in street railway securities.

The *Electrical Review* of London had occasion recently to felicitate itself on the publication of its 1001st number. It commenced publication in 1872, "when no other electrical paper now appearing was in existence," and soon developed into a semi-monthly, coming out as a weekly 15 years ago. This quarter-century's record of progress shows very creditable achievement, and we extend our congratulations.

The anniversary serves, however, to direct attention to the curious fact that America has no monopoly of the disagreement regarding the priority of electrical journals. But there is the difference that while in the United States there are three claimants to the doubtful honor, in England, so far as we are aware, there are only two aspirants—the one named and our esteemed contemporary, the *Electrician.* The subject has interested us sufficiently to induce us to collect the salient facts in the British case in the form of the subjoined table:

Name of Journal.	Date of Issue from which Information is Obtained.	Self-designation as to Age.	No. of Vol.	Total No.
Electrical Review	April 16, 1897.	The oldest weekly electrical paper. Established 1872.	XL.	1,012
Electrician	April 16, 1897.	The oldest electrical journal (established as a weekly journal, 1861–1878).	XXXVIII	987

This shows the *Electrical Review* to be in the lead in the showing of volumes and total number of issues; but the *Electrician,* it must be admitted, is a close second, and, of course, it may catch up in the total numbering by appearing at more frequent intervals than its rival, as semi-weekly or daily, although in the number of the volumes its case appears to be hopeless, except in the very unlikely contingency that the *Electrical Review* may discontinue publication. The dates in the claims —1861, 1872 and 1878—are confusing, and we confess that we cannot reconcile the two statements. How, for instance, if the *Electrician* were appearing as a weekly journal from 1861 to 1878, could the *Electrical Review* have made its first appearance in 1872 "when," to quote again, "no other electrical paper now appearing was in existence"? And, going one step further, how is the *Electrical Review* the "oldest weekly," when the *Electrician* was "established as a weekly journal" eleven years before it commenced publication? These are puzzling questions; but we know from the great attention the subject has attracted in the case of the American journals that it is of vast moment; and therefore it is well that the truth should be known. Probably there are many nice distinctions—such as the exact time when a telegraphic paper blossomed out as a full-fledged electrical journal, and when a monthly became a weekly—that must be determined in England as in this country before this great question can be settled aright. As the WESTERN ELECTRICIAN has never been anything but a weekly (unless exception is taken for a short period when it was issued daily), and as it was established as an electrical journal pure and simple, we take merely an academic and dispassionate interest in our contemporaries' contentions. Our hope is simply to see an important scientific inquiry carried to a satisfactory and authoritative conclusion.

Barrett Apparently Slated for Removal.

If the *Record, Times-Herald* and *Chronicle* are not entirely mistaken, John P. Barrett's malodorous career as superintendent of city telegraphs of Chicago is nearly closed. All three of these important newspapers agree that Barrett is to go. The following extracts give estimates of the situation up to April 27th:

Prof. John P. Barrett and his methods of doing business for the city telegraph department and electric light plant are being investigated by Mayor Harrison. The Brotherhood of Electrical Mechanics has demanded his removal and presented the mayor with evidence on which to base its charges that the veteran of the city electrical service is unfit to hold a place of responsibility.—*Chicago Record*, April 24th.

These city officials are slated for retirement by Mayor Harrison, and their successors will be appointed within a week: John P. Barrett, superintendent of city telegraph. [Several other names are mentioned.] For the last week Mayor Harrison's office has been thronged with people demanding the retirement of Superintendent Barrett. Labor and trades organizations have filed protests against his retention, and their petitions have been carefully considered, as have the public and private charges brought against Superintendent Barrett's management of the office. The most surprising thing to the political lieutenants of Mayor Harrison was that almost everybody that waited upon the chief executive regarding Superintendent Barrett insisted that he be removed. One of the mayor's closest friends said yesterday: "Why, it seems as if all the town is after this man Barrett. I don't know what is the matter with him, but they are after him and demand his scalp, and you know in times like these it is much easier to get a man's job than to find one for him. The charges in the *Record* concerning Barrett's management of the office have been looked into, and besides that I understand that other charges have been made. Before his honor the mayor acts in the matter I suppose, of course, he will afford Barrett an opportunity to offer a defense. He will be treated fairly, but I believe he is certain to go."—*Chicago Record*, April 27th.

John P. Barrett, city electrician, for 20 years in the service of Chicago, is to go. Superintendent Ellicott of the Western Supply company may be the successor of Mr. Barrett as city electrician. Mayor Harrison sent for Mr. Ellicott yesterday and had a conference with him, and his selection is expected. Meanwhile the charges against Barrett's management of his office come pouring into the mayor from electrical supply men and insurance agents. The charges are made so vigorously that Barrett's retention seems now impossible, although he has not given up hope. One of his friends called on the mayor and denounced the opposition to him as "carrion." "Well," said the mayor, "it is the healthiest lot of carrion I have seen for a long time."—*Chicago Times-Herald*, April 25th.

It is not expected that Mr. Barrett's declaration or explanation will save him. The place is wanted for someone else. It has a good salary, some patronage and rich perquisites to a man who might be willing to make all out of the office that would be lawful for him to make and not be subject to investigation.—*Chicago Times-Herald*, April 26th.

The announcement made unofficially last night that Mayor Harrison will in a few days appoint a successor to Professor John P. Barrett, superintendent of the fire-alarm service of the Fire Department, caused a sensation in the city hall. It is understood that Professor Barrett will be given the alternative of resigning or standing trial on some of the charges that have been preferred against him. Mayor Harrison is acting entirely on his own responsibility in this matter, and has not consulted Chief Swenie of the Fire Department, who, it is said, indicated that he did not want to be mixed up in the affair. There has been a decided coolness between the chief and the professor, according to all reports, since Barrett undertook to have his department separated from the fire department by ordinance. The charges against the professor in the main relate to favoritism as to certain concerns that deal in electrical supplies needed by the city. Professor Barrett has frequently denied these charges and expressed a desire to meet and explain them. The mayor will leave the selection of Professor Barrett's successor to Chief Swenie, who will follow the merit system that has been in vogue in the Fire Department for 20 years. It is not unlikely that David M. Hyland, chief operator, will be promoted to be superintendent.—*Chicago Chronicle*, April 27th.

National Electric Light Association.

Arrangements have been made with the management of the International Hotel and Cataract House, Niagara Falls, to take care of members and delegates of the National Electric Light association attending the twentieth convention, which will begin on June 8th and last three days. Rates range from $3 to $5 per day, American plan. The headquarters and convention hall will be at the International Hotel. Floor plans of both houses can be seen at headquarters of the association, 136 Liberty street, New York, where reservation of rooms can be made.

The seventeenth quarterly statement of the Western Electric Building & Loan association of Chicago shows the organization to be in excellent financial condition.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part IV.

Water Supply. Purifiers, Heaters, Economizers, Pumps, Condensers, Separators, etc.

We are now ready to trace the circulation of the water from its source, through the boiler-feed pumps, thence into the heaters and through the boiler, emerging as live steam to pass through the separator, and on to the engine, where it gives up most of its heat, producing mechanical motion, exhausting finally through a feed-water heater into a condenser, from which a portion of it, in case of a jet condenser and all of it in case of a surface condenser, is pumped back into the boiler to be used again. We have seen that each boiler horse power requires about 30 pounds of water per hour. A boiler of 100 horse power will require about 360 gallons per hour, which, at 8⅓ pounds per gallon, will equal nearly 1½ tons.

Water Supply.—The importance of taking into consideration the supply of water for the boilers when selecting a site for the power house is apparent. The first consideration is that the water should be as pure as possible. To get absolutely pure water is an impossibility. The amount of impurities varies from about one-fifth of a pound per ton of water to as much as five pounds per ton. If water containing the latter amount of impurities were allowed to deposit all the foreign matter in the boiler, the result would be, in a 100 horse power boiler working, say, 10 hours per day, an accumulation of over a ton of matter in a month, which, if not cared for, would seriously interfere with the operation of the boiler.

In considering a possible source of supply it is well to have the water examined and analyzed by an expert chemist, who, in his report, will be able to point out the proper course to pursue to prepare the water for use. The impurities and foreign substances which will have an injurious effect on the boilers and may affect its economy in operation may be classed as follows:

1.	Suspended matter	Sediment, mud, clay, etc. Insoluble mineral matter. Organic matter. Grease (from exhaust).
2.	Dissolved salts.	Bicarbonate of lime, magnesia and iron. Sulphate of lime. Chloride and sulphate of magnesium Carbonate of soda.
3.	Acids.	Carbonic. Sulphuric. Nitric.

The methods adopted for the prevention or remedy of the troubles caused by the various impurities in the water are far more numerous than the troubles themselves. Some are as good as the others are bad.

Filtration.—The first method of prevention to be considered is filtration. This method will remove a large amount of the mechanically suspended matter carried in the water. The commercial filters upon the market use a great variety of substances to catch and remove the suspended solids. Sand, gravel, charcoal, excelsior, hay and cloth are all found useful. The main point to be considered in selecting a filter is easy access for cleaning the filter, for the effectiveness of any filter will depend upon keeping it clean. Many filters are designed to be self-cleaning—automatically removing and discharging the impurities. The quantity of impurities in a given amount of water, nature of the material to be removed and the quantity of water to be purified by the filter will determine its size and dictate its selection. Whether a filter is or is not thought necessary, a strainer of a type readily cleaned and inspected should be connected to the inlets of all boiler feed-water. It will in some cases be found advisable to admit the water first into settling tanks, where the water, by standing, will allow the suspended particles to settle; but even after the visible, mechanically suspended particles have been removed from the water, there yet remain scale-making impurities in the water which may have a decidedly injurious effect upon the life and action of the boiler.

The principal scale-producing materials are bicarbonate of lime and bicarbonate of magnesia. These are salts soluble in water and are known as unstable salts; that is, their combinations are not fixed, so that when they are heated one particle of carbonic acid is driven off, and they are transformed into monocarbonates, which are insoluble salts, and are precipitated. Hence, the largest possible surface of coke or other filtering material should be used, in order to take care of the large volume of precipitated matter. The carbonic acid, when driven off, attacks sheet iron or sheet steel. If the precipitation is made in the boiler, this action is made evident by pitting the interior of the shell. Carbonic acid does not attack cast-iron, however; hence the advantage of using cast-iron for the construction of heaters and causing the precipitation to take place in them instead of in the boiler.

Boiler Scale.—The impurities enumerated in the table may produce one of three effects—priming, corrosion, incrustation. Priming may be caused by organic matter in the water or by an excessive amount of carbonates. Corrosion will result from acids, grease or dissolved carbonic acids. Incrustation will be the effect if there are in the water carbonates of lime, magnesia or iron, sulphate of lime or chloride of magnesium. These incrustations are usually known as "scale" and are very difficult to remove. If they cover the heating surface, they reduce the efficiency to a very marked degree. It is a common estimate that scale one-sixteenth inch thick will reduce the efficiency nearly 10 per cent., one-fourth inch almost 45 per cent. more, while with scale one-half to three-fourths inch thick it will be found necessary to burn nearly double the amount of coal to evaporate a given amount of water.

It is possible to prevent incrustation by introducing suitable chemicals in the feed-water before it enters the filter or settling tanks. The object of these chemicals is to precipitate the impurities, in which form they can be easily removed. For instance, if lime water is introduced into feed-water containing the carbonate of magnesia or of lime, the carbonate of lime will be precipitated and may be entrapped in the filter. The addition of the carbonate of soda will precipitate the sulphates of lime and magnesia. These precipitates are far less injurious to the boiler than the hard, tenacious scale. Often they can be removed from the heating surfaces by what is known as "blowing off." In every boiler calculations are always made to permit this operation, during which a certain amount of water is allowed to escape under pressure from some part of the boiler, such as the "mud drum," it being the intention to have this rush of water carry off the impurities which have collected. This method of precipitating the impurities by means of chemicals, while perfectly feasible, has some practical disadvantages, the trouble being usually that neither the proper amount nor kind of chemicals is introduced. There are upon the market many "boiler compounds" whose object is to soften, loosen or dissolve the scale, but, unless an analysis of the water is made and a compound especially applicable to it is selected, the result is often disappointing and ineffectual.

Oil is sometimes introduced into the boiler, the object being to prevent scale, but trouble has often been caused by an unintelligent use of an improper kind of oil. There is no doubt that a pure grade of petroleum will have beneficial results, but care should be taken that any oil introduced into the boiler be free from grease or animal fats. Grease will form a coating over the heating surface which will interfere with the cooling action of the water and consequently the plates or tubes overheat and weaken. Furthermore, as already mentioned, heavy oils cause the water in the boiler to foam, resulting in wet steam.

Purifiers.—The most usual and by far the best way to prevent scale is by removing the impurities which form it by means of a steam feed-water purifier. In this device advantage is taken of the fact that the compounds of lime, magnesia, etc., in the water become insoluble if the water is heated to a temperature of 300 degrees Fahrenheit, and by an apparatus designed for the purpose can easily be removed from the water. Feed-water purifiers are known as exhaust purifiers and live steam purifiers. In the case of exhaust purifiers the water is heated by means of the exhaust steam; consequently the temperature which can be attained is only about 200 degrees Fahrenheit. At this temperature the carbonic acid which holds the lime or magnesia in solution is driven off, and in consequence these minerals are precipitated. It takes a higher temperature, however, to affect the sulphates. This temperature is obtained, in a live steam purifier, by using steam directly from the boiler, by which the temperature of the feed-water is raised to a point equal to the temperature of the steam in the boiler. A temperature of 300 degrees Fahrenheit (or that of steam under a 52 pound gauge pressure) is sufficient to precipitate the sulphates of lime and magnesia, the two impurities which are the most objectionable.

The typical live-steam purifier consists of a cylindrical shell constructed sufficiently strong to safely withstand the boiler pressure under which it is expected to work, in which are placed a number of shelves or pans arranged one above the other in such a manner that the contents of each one are delivered to the one immediately underneath it. The boiler feed-water is delivered onto the topmost pan. The pan will soon become filled and the surplus water overflow to the pan immediately under it. In this manner a certain volume of water is held momentarily in each pan and the precipitate is allowed to collect on the pans. These pans are removed and cleaned at suitable intervals. The interior of the purifier is connected directly to the boiler, so that live steam circulates around and over the pans and thereby imparts to the water the temperature of the steam within the boiler, and, as this is always over 300 degrees Fahrenheit, precipitation of the sulphates takes place in the purifier, and only the pure water enters the boiler. The live-steam purifier is usually placed on top of the boiler, thus allowing the water to be delivered into the boiler by gravity.[1]

In asking for bids on purifiers the following conditions and facts should be observed:

First—The analysis of the water should be furnished.

Second—The temperature of the steam under which the purifier is to work.

Third—The temperature of the feed-water when it enters the purifier and the desired temperature of the feed-water when it leaves the purifier.

Fourth—the maximum amount of feed-water that is to be passed through the purifier in one hour.

Feed-water Heaters.—It is almost self-evident that a power station should be equipped with a feed-water heater. If the plant is running non-condensing, fully eight-tenths of the original heat contained in the steam remains in it after it passes through the cylinder or cylinders of the engine. This heat can be utilized by means of feed-water heaters to raise the temperature of

1. The lecturer illustrated several types of standard purifiers, by means of lantern slides, and explained their action. A slide showing a pan from a purifier, before and after collecting a deposit of lime, was also used.

the water before it passes into the boiler. Every 12 degrees added to the temperature of the feed-water by exhaust steam in this way saves about one per cent. of fuel. It can be easily figured, then, that if the feed-water be at an average temperature of 60 degrees Fahrenheit, and by means of a heater its temperature be raised to 210 degrees Fahrenheit, the saving in fuel alone will be over 12 per cent.—a figure which is reached in actual practice. Feed-water heaters have additional advantages of avoiding the feeding of cold water into the boilers, and thus the straining of the shell from sudden changes in temperature is prevented. The back pressure on the engine is also somewhat reduced, owing to the condenser action of the heater, while the raising of the water to a temperature approaching the boiling points results in the removal of many impurities.

Feed-water heaters are of two distinct types, known as closed heaters and open heaters. Closed heaters consist of a system of pipes contained in a closed vessel. The steam circulates either through the pipes or about them, thus imparting its heat to the water which surrounds the pipes or is contained by them, depending upon the design of the heater. These heaters have the advantage of keeping the water and steam separated, thus preventing the oil which is taken up by the steam in the cylinders of the engine from reaching the boiler. Open heaters consist, as a rule, of a system of open pans placed one above another in such a manner that the feed-water overflows from one to the other in the same manner as in a live-steam purifier. The water is exposed directly to the action of the steam. The oil contained in the exhaust must be removed by an efficient oil separator before the steam reaches the water. Open heaters have one or two advantages over the closed types. The steam used to heat the water in an open heater is condensed in the operation and re-enters the boiler, thus avoiding the use of an equivalent amount of impure feed-water and utilizing all of the latent heat of the steam so condensed. The facilities for purifying the water are much better, and owing to the fact that the heater is not operated under boiler pressure, the construction may be lighter and of less expensive material, resulting in a low first cost.

[Several typical forms of open and closed heaters were shown by means of lantern slides.]

Economizers.—An economizer is another form of boiler feed-water heater which utilizes a large portion of the heat of the flue gases, which otherwise would be wasted by being allowed to escape directly into the chimney. In its latest and most improved form it presents the appearance of a huge steam radiator, consisting of a bank of vertical cast-iron tubes about four inches internal diameter and nine feet in length, hydraulically pressed into cast-iron headers and placed directly in the line of passage of flue gases just after they leave the boiler setting. Through these tubes, which are surrounded by the hot gases from the furnaces on their way to the stack, is pumped the feed-water for the boilers. To the water is imparted a large portion of the heat of the flue gases, thus raising the temperature of the feed-water.

Besides effecting a very material saving in fuel, an economizer has the same effect as adding heating surface to the boiler plant, which increases its steaming capacity. The amount of saving which an economizer will effect in a given station depends on the conditions existing in that station, viz., the temperature of the boiler feed-water, the temperature of the flue gases and composite elements of the flue gases, on which depends the number of heating units per cubic foot of flue gas.

In some of the best modern power stations where all steam is condensed and where the conditions are such that an exhaust steam pipe is used only occasionally, the conditions are still more favorable to the use of economizers, inasmuch as, in order to prevent cold water from entering the boilers, it is necessary to use economizers or live-steam purifiers. Where the use of live-steam purifiers would not result in any saving, by removing impurities from the water, owing to local conditions, where good water can be obtained the advantage of economizers is apparent. Where the feed-water is bad the use of live-steam purifiers and economizers in conjunction is advisable, feeding the economizers from the hot well, thence through the purifiers to the boilers. The purifiers would in this case receive the water from the economizer at a temperature at or about 260 degrees Fahrenheit, and the use of live steam would only be required to make the difference between 260 degrees and the temperature of the water at steam at the boiler pressures used. In the latest condensing stations the highest temperature of feed-water for the boilers seldom runs above 110 degrees, and in case of electric railway stations this temperature is considerably lower on account of the variation of the load on the engine.

Assuming a station working under average conditions of feed-water and flue-gas temperature, which will be about 180 degrees Fahrenheit and 475 degrees Fahrenheit respectively, a saving in fuel of 11½ per cent. would be gained by the use of an economizer. This saving is based from reports of actual tests showing a gain in feed of 77 degrees for every 100 degrees reduction of flue gases. A gain, therefore, of 115 5 degrees in feed would result from a reduction of the gases from 475 degrees Fahrenheit to 325 degrees. Deductions from computation of tables of well known steam authorities show us a theoretical gain, by raising the feed-water from waste sources, of .0943 per cent. for every one degree Fahrenheit added to the feed-water with boilers carrying 120 pounds steam pressure above the atmosphere.

In no case do we find water above 212 degrees Fahrenheit leaving a feed-water heater unless the gain in temperature is due by direct loss in fuel. An economizer will take feed-water at 212 degrees Fahrenheit, and with flue gases at 475 degrees Fahrenheit to 500 degrees Fahrenheit raise the feed-water to about 300 degrees Fahrenheit, or about the temperature of steam at 62 pounds per square inch. It has been found, however, that in actual practice and as the result of a number of evaporative tests by reliable experts, economizers have shown a saving of from 1 2 to 1.4 per cent. in fuel for every 10 degrees rise in feed.[1] It may be safely stated, therefore, that with feed-water entering the economizer at an average of 190 degrees and leaving the economizer at 272 degrees average, the actual saving in fuel will not be less than 10 per cent.

The question of economizers and stack draught is one that has recently had close attention. Where the gases are above 550 degrees Fahrenheit, the reduction of flue gases to 400 degrees will not materially affect the draught, for the reason that stacks are usually designed in height on the basis of gases leaving the boiler flue at or about 400 degrees. Economizers are being successfully used in many instances where they have been installed as an after-consideration, and where no provision has been made in stack proportions for their use. This would tend to show that in an ordinary station of to-day, with gases of 500 to 550 degrees, economizers can safely be used without increasing the stack capacity.

It has been found in recent tests that while the economizer reduced the flue gases to 400 or even as low as 350 degrees, it at the same time, by raising the feed to 300 degrees necessitated the use of less boiler power and less fuel consumed under the boilers. Consequently the stack has less boiler power to provide for and is able to handle the heavier gases to good advantage.

Where the gases, however, are to be reduced below 350 degrees, even as low as 220, additional stack should be provided for when the station is built. This can very cheaply be done, owing to the fact of the modern method of the use of steel stacks in place of brick, and the cost of 10 to 20 additional feet in height in a steel stack is very low in proportion to the advantage gained in fuel economy due to the use of economizers.

Where a plant is already built and economizers are to be installed, and where no provision is made in stack proportion, if the gases are to be reduced below 350 degrees a small induced-draught fan should be placed between economizer and stack to supply by mechanical means the loss in rapidity of travel due to the very low temperature of gases at base of stack.

[Slides and blue prints were used to show the construction of the economizer, the connections of the water supply to the boiler and the method of cleaning the tubes by means of scrapers operated by an independent motor or small engine.]

Feed Pumps take the water from the source of supply and deliver it through the heaters into the boiler. The pump should have few parts, and be of the simplest possible design. It should be strong in all its parts and easily adjusted. It is imperative that the pump keep a steady flow of water to the boiler, the amount depending upon the variations of the steam demand. If the pump should act intermittently, the feed-water would enter the boiler first very hot, next very cold, and the result would be injurious straining, due to the expansion and contraction.

Of independent boiler feed pumps there are two general types—fly-wheel pumps and direct-driven pumps. Fly-wheel pumps operate with better economy on account of using steam expansively. They cannot, however, be regulated with certainty on very slow speeds on account of their tendency to stop on dead centers. The fact that the direct-acting pump has no centers allows it to be started from any point and also makes it possible to control the delivery according to the demand for water. The steam is not worked expansively, however, and this results in poor economy, but the easy control of the direct-acting type has made it very popular with most power station designers; but lately there is a tendency to adopt independent pumps driven by electric motors. This type obviates many of the disadvantages of the types just mentioned.

In piping to the boiler the connection should be made so as to give the feed-water a motion in the same direction as the boiler circulation.

In controlling the pump it will be better to regulate the supply of live steam rather than by placing a valve in the suction, as the latter method will result in shocks due to the piston suddenly encountering water. Shocks will also result if an attempt is made to lift hot water against the force of gravity, as the suction will cause steam to form on account of a reduction of pressure. In handling hot water the supply should, therefore, always gravitate toward the pump. The valves in a pump intended to handle hot water should be preferably metallic or hard rubber, as the heat will soon destroy the ordinary soft-rubber type.

It is customary to operate boiler feed pumps at a speed of forty or fifty feet per minute, and they should never be installed with the expectation of operating them more than 100 feet per minute.

Operation of Pumps.—Besides the feed pumps there may be required in the plant a circulating pump to force water through the condenser or heaters, and an air pump in connection with the condenser. There are two general methods of driving these pumps, as follows:

1. By connecting the pumps directly or indirectly to the engine of the power plant. This can be done by driving directly from the cross-head or piston-rod of the engine, or by belts, shafting or gearing, or with an electric motor deriving current from the generator operated by the engine.

2. By operating the pump by means of independent steam cylinders directly attached.

The first method has been used extensively in marine practice, and is beginning to be adopted in electric power station work, but it is open to the objections that it permits little choice of the location of the pumps and that the pumps can be operated only when the main engine is running. As a general rule the second method will be found to be the more satisfactory one. The main objection that can be urged against the independently driven pump is that in the small steam cylinder of the pump the steam is used less economically than in the larger cylinder of the main engine. At first sight it would seem that better economy would result by driving the pumps directly from the main engine, and this is undoubtedly the case with non-condensing plants. But if the engines are condensing, then it will be a question whether it will not be better to run the pumps independently and use the latent heat of their exhaust steam in an open heater to raise the temperature of the boiler feed-water.

Take, for instance, the case of a 1,000 horse power condensing engine using 15 pounds of steam per horse power hour at a boiler guage pressure of 140 pounds and feed-water at 110° Fahrenheit. The feed-water may be heated to a temperature of 135° Fahrenheit in a closed heater placed between the exhaust of the engine and the condenser. The auxiliary pumps for circulating water, air pumps and boiler feed-water, etc., will require about three per cent. of the total, or 30 horse power.

Total heat in steam at 140 pounds gauge=1,224 B. T. U.

British thermal units required to evaporate one pound of water. from 135° Fahrenheit to 140 pounds pressure (1,224—135)=1,809.

Water required (1,030×15)=15,450 pounds.

Heat required if all pumps are operated by main engine (15,450×1,089)=16,825,050 B. T. U.

Now assume that the pumps operate independently and exhaust into an open heater imparting 95 per cent of the latent heat of the exhaust to the boiler feed-water. Allow the pumps 40 pounds[1] of water per horse power hour; the total water consumption is as follows:

Engine (1,000 horse power at 15 pounds)	15,000 pounds
Pumps (30 horse power at 40 pounds)	1,200 pounds
Total	16,200 pounds

The latent heat in the pump exhaust (1,200×966)=1,159,200 B. T. U.; 95 per cent. of 1,159,200=991,240 B. T. U.; 991,240÷16,200=61 degrees Fahrenheit, which is the rise in the temperature of the feed-water due to the pump exhaust. The heat required to evaporate one pound of water (1,224—135—61)=1,028 B. T. U. The heat required if pumps are operated independently (16,200×1,028)=16,653,600 B. T. U.

This shows a saving of over one per cent. in favor of the independent driven pump plan. With different conditions this result will vary, but this calculation has been introduced simply to show the method of considering the question in any particular case.

Injectors.—These well-known devices for feeding water into the boiler by means of the steam of the boiler itself are usually provided and piped in such a way that they can be used independently, so that in case of accident to the pumps or heaters the boilers can be supplied by means of the injectors. They are cheap, simple, compact, have no moving parts, and have the advantage of delivering hot water to the boiler on account of utilizing the latent heat of the steam supplied to them; but pumps operating in connection with heaters are more economical.

Steam Separators.—Every precaution should be taken to insure that the engine be supplied with "dry" steam. In the first place dry steam should be generated by the boiler under all conditions, but, failing this, provision must be made to take all the entrained water or moisture out of the steam before it is allowed to enter the engine cylinder. If too much water is carried with the steam it is liable to wreck the engine. A steam separator should be placed in the live-steam pipe as near as possible to the engine. This position will enable it to catch all the water in the steam which may be due either to the improper operation of the boiler or the condensations resulting from long or uncovered steam pipes. There are several forms of separators. Some work upon the principle of giving a spiral or centrifugal motion to the water and steam, which results in the heavy water seeking the outside of the chamber while the lighter steam remains nearer the center, from which it is allowed to escape. Other separators destroy the momentum acquired by the liquid carried along in the current of steam, and, by changing its direction, separate the steam from its entrained water. An efficient steam separator will not allow over one per cent. of water to get by it and reach the engine cylinder. The water accumulates in the bottom of the separator and can be removed by means of a trap, by a drip operated by hand or by two

1. This is about 33 per cent. higher than the theoretical saving when calculated by the established formula for heaters, as follows:

$$\text{Gain per cent.} = \frac{100\,(T-t)}{H-t}, \text{ where}$$

H = Total heat of steam at boiler pressure above 0° F.
T = Temperature of feed-water after heating.
t = Temperature of feed-water before heating.

This gain over the theoretical is probably due to an increased efficiency of the boiler, owing to its being relieved of a portion of its work by the economizer.

1. This figure is taken as the best result that may be expected from the highest type of modern fly-wheel automatic cut-off pumps. The majority of direct-acting pumps which work steam full stroke (the type which is used in almost all small plants and many large ones at present) consume from 80 to 150 pounds of water per horse power hour, and when such pumps are used the result of this calculation shows largely in favor of the method of driving direct from the engine.

other means, which will be described later under the head of piping.

Combined Separator and Receiver.—A good separator can be made out of a simple large tank or reservoir, into which the steam enters from the side and leaves from the top, the entrained water collecting in the bottom, from which, by means of a suitable trap or other device, it can be returned to the boiler. This tank may act as a receiver as well. For instance, suppose it to contain but six times the volume of the high pressure cylinder and the latest cut-off of the engine be not over one-third stroke at full load. The steam separator then would contain sufficient steam supply right at the engine for 18 strokes. Thus, in case of a sudden increase in load, the excessive drop in the pipes due to the extra demand for steam, is prevented. The vibration of the pipes due to a suddenly varying load is also overcome.

Oil Separators.—It is always desirable to remove from the exhaust steam the oil introduced in the live steam on account of the lubrication required by the engine cylinders; this oil may be purified and used over again in many cases. In any event if it is allowed to remain in the exhaust steam it becomes objectionable; and especially is this true where the steam passes through condensers, open heaters or radiators, or where the water obtained from the condensed steam is used over again, by being pumped back into the boiler, as is the case where a surface condenser is used. The danger of allowing a heavy oil to accumulate in the boiler has already been pointed out. Oil extractors or separators are constructed upon a variety of principles. Some act as ordinary filters and are packed with hay, straw, sand or use cloth as a filtering medium. Other separators have metallic deflecting or baffling plates upon which the oil impinges and accumulates and from which it drips into pockets. It is important to remove the oil while it is suspended in the wet steam, as, after condensation, the oil seems to form an emulsion with the water, and the separation of the oil then becomes extremely difficult.

Exhaust Heads.—An exhaust head is a device placed at the end of the exhaust pipe to prevent the noise of the exhaust becoming objectionable, and also to catch the oil in the steam which would otherwise fall upon the roof or upon surrounding structures. It acts upon much the same principle as a live-steam separator, the idea being to deflect the solid particles in the exhaust by means of baffle plates. The oil and condensation are caught and carried away by a drip pipe, while the steam is allowed to escape through the enlarged area of the exhaust head at such a reduced rate that no noise is made. It is used only in non-condensing plants or on the atmospheric exhaust pipes of condensing plants. In the latter case it is used only occasionly when the condensers are not working.

Condensers.—The condenser is connected to the exhaust of the engine and maintains a vacuum by providing an air-tight apartment in which the steam is condensed, and from which the air is constantly exhausted. There are two general types—jet condensers and surface condensers—the classification depending on the method in which condensation is effected.

In jet condensers the water which condenses the steam comes in direct contact and mixes with the steam. This water is usually termed the "injection water," or, perhaps, only the "injection." Jet condensers are the more compact, and require less injection water than other types, this amount of water being usually 30 to 35 times the weight of the steam condensed. The jet condenser is also less expensive in first cost, and more easily cleaned, but if the water of condensation is to be used over again the injection must be pure water and not objectionable for use in the boiler.

In surface condensers the condensation is effected by indirect means, and the injection water does not come in contact with the exhaust steam. This is effected by separating the water and steam by metallic plates or tubes, one side of which is kept cool by the circulation of cold injection water. For better efficiency the tubes or pipes of a surface condenser are made of brass or copper, as these metals allow of the most rapid transfer of heat. As the exhaust steam is not mixed at all with the condensing water an impure injection water may be used, and at the same time the condensed exhaust can be returned to the boiler and used over again. As in a closed heater, the steam may circulate inside the pipes with the water outside in the shell, or the arrangement may be reversed. With the surface condenser a very poor quality of injection water can be used, and it is for this reason often preferable. The injection water is forced through the surface condenser by a separate pump, known as the circulating pump, but with either type of condenser an air pump will always be required. It is the function of the air pump to maintain the vacuum created by the condensation of the exhaust steam by the injection water. With jet condensers the air pump handles the air, condensed steam and also the injection water, but with surface condensers only the air and water of condensation are removed by the pump. It may be a single-acting pump with both types of condensers, and may be driven by either connecting to the main engine or by an independent engine cylinder. As in the case of the feed-water pump, both methods have advantages. The independent method of driving is the more convenient, allows better regulation and can be run even when the main engine is not in use, thus permitting a vacuum to be produced before starting up the main engine.

[Lantern slides showing typical forms of pumps, condensers and separators were shown.]

["Engines" come next in the consideration of the general subject, and this forms the subject of the fifth lecture.]

Orne Telephones.

Three types of the telephones manufactured by the Orne Electric Construction company of Chicago are shown by the accompanying illustrations. Fig. 1 represents a long-distance telephone with this company's long-distance transmitter, mounted upon an adjustable arm similar to a ball and socket joint, so that the transmitter may be adjusted in any direction and also revolved to prevent packing. The instruments are equipped with hard-rubber receivers and a switch hook of new design, which gives positive connections. The generator of the magneto is wound to 10,000 ohms; the ringers can be wound to either 250 or 1,000 ohms for multiple circuits.

Fig. 2 shows the Orne type of desk telephones. The transmitter is of the same construction as on the long-distance telephone; the stand is made of heavy brass and is highly nickel-plated; the base is made of highly polished black walnut and contains the induction coil and binding screws for all wiring connections. Extra buttons, switches, etc., may easily be mounted on the wooden base, so that this instrument may be used for any system of wiring.

Fig. 3 represents an intercommunicating instrument equipped for 14 stations. This telephone is intended for

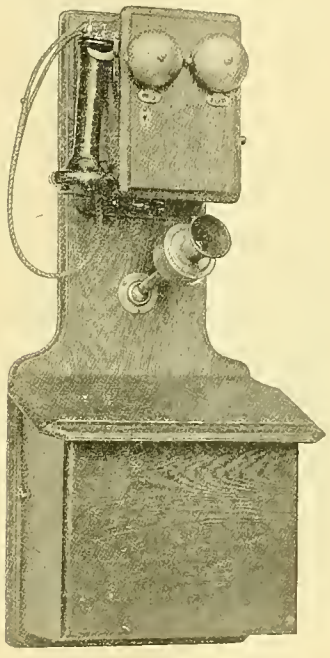


FIG. 1. ORNE TELEPHONES.

plants comprising less than 50 instruments, where intercommunication is desired. Any number of pairs of telephones can communicate simultaneously without interference. To call another instrument, by inserting the plug instant connection is obtained; if the desired station is busy, a busy signal is obtained. The act of hanging up the receiver automatically ejects the plug, thus doing away with the possibility of forgetting to take the plug out, which seems to have been the principal trouble with intercommunicating telephones which are not automatic. This instrument is made of highly polished black walnut, has the long-distance transmitter mounted on this company's arm, hard rubber receiver and a special five ohm bell. A magneto bell may be substituted for this bell where instruments are used on long lines.

Death of W. B. Somerville.

William B. Somerville, superintendent of the press service of the Western Union Telegraph company, died at his home in New York on April 24th. Mr. Somerville was born in Toronto, April 28, 1840, and began telegraphing at the age of 18. He served through the war as a military telegrapher and afterward entered the Western Union service at Louisville. He became interested in the work of news-gathering by telegraph and was connected with several of the older press associations, resigning the position of general manager of the National Associated Press in 1879 to assume the position he held at the time of his death. Mr. Somerville had a wide acquaintance, especially among newspaper men, and was well liked.

A 500-light Arc Machine in Prospect.

Prof. Sidney H. Short of Cleveland has been spending some time in Chicago. He speaks enthusiastically of the electrical prospects of the Walker company, and states that a line of alternating machinery (including induction motors), another of multipolar arc machines and a third of long-distance apparatus for power transmission are about to be brought out by his company. The arc

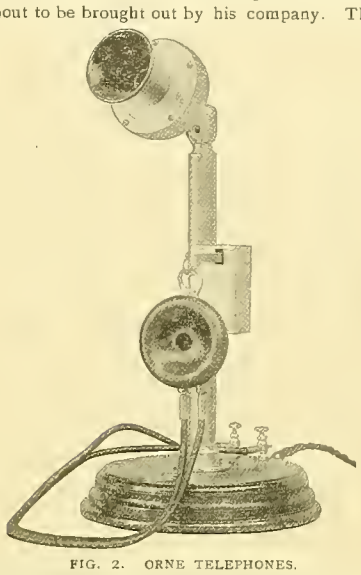


FIG. 2. ORNE TELEPHONES.

dynamos, he says, will be built for direct connection and slow speed, having a capacity as high as 500 arcs to a machine. To attain this result without prohibitive voltage in the line circuits, the 500-light machines are designed on the multiple-circuit principle, each supplying five 100-light circuits. This keeps the pressure within 5,000 volts. The 500-light dynamo has 10 poles.

In railway work the company reports success at home and abroad. It is building new motors for the Lake Street "L" in Chicago, these being of a special type designed for elevated railway work. The Lake street motors are to weigh 8,000 pounds each and are rated at 200 horse power. With these powerful motors—two to a train—the speed of operation will be greatly increased. The new generators in the Forty-ninth street plant of the Chicago City Railway company are said to be the largest in existence not direct-coupled to the engines. They are of 1,170 horse power each. The Walker people are shipping to Paris what are said to be the first American-made electric motors to be used on the streets of the French capital. They are also equipping (with

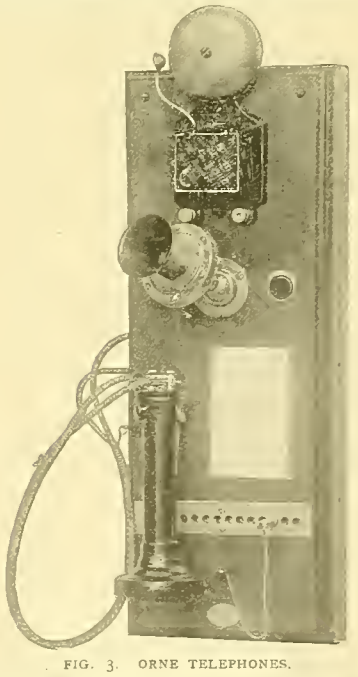


FIG. 3. ORNE TELEPHONES.

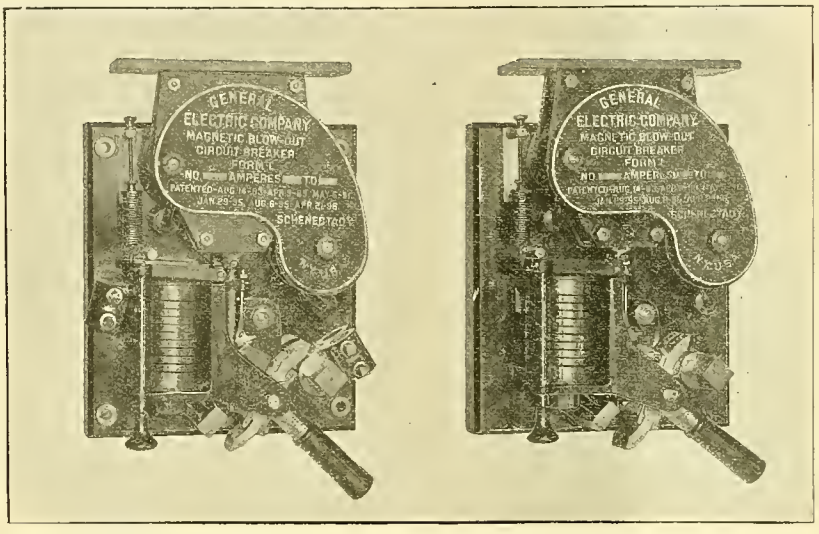
motors) through the European company an interesting electric railway in Upper Silesia. It is 40 miles long and has 100 cars, but operates on a gauge of only 31 inches. An order for a complete railway equipment has been received from Japan, and electric railway machinery made by the Walker company has also been sold in Berlin, Portugal and Italy.

Automatic Circuit Breaker for Light Currents.

The automatic circuit breaker of the General Electric company, known as form K, for heavy currents, is now followed by one for use with smaller currents, i.e., for 100 to 500 amperes. It is known as the form L, and, as with form K, may be used on any potential up to 750 volts.

The deleterious effect of arcs on unprotected contact parts destroys in a short time their usefulness, introducing a serious problem on all circuit-breaking apparatus, and the greater the voltage and current the greater the difficulty presented in handling arcs. To eliminate the destructive effect of arcs on contacts the magnetic blowout principle was applied, and by this a means is provided for destroying the arc at the moment of its formation. The addition to a switch thus equipped of a tripping device to open the circuit as soon as a predetermined current flows gives an automatic circuit breaker unsurpassed for reliability and convenience.

The form L circuit breaker is substantial in construction and compact in form, as shown by the illustration. It is mounted on a slate base 11 by 12½ inches, and the maximum over all measurement from the back of the base is six inches. It can be provided with either front or back connections. Its action is similar to that of the (form K) circuit breaker adopted so widely in power stations for use with heavy currents. The current passes through built-up leaf contacts to the tripping coil, the armature of which actuates the tripping device. An adjustable tension spring holds the armature away



AUTOMATIC CIRCUIT BREAKER FOR LIGHT CURRENTS.

until sufficient current flows to overcome its pull, drawing the armature to the magnet coil.

The leaf contacts are held normally against the main contact blocks. When the tripping armature is drawn to its magnet the main contact is released and the circuit instantly opened by the action of the main spring. To prevent arcing at the main contact the current is shunted through a secondary contact plug protected by the blow-out magnet. This plug is not withdrawn until after the leaf contacts have left the contact blocks, and all tendency to arc, therefore, is confined to this point, where the magnetic action prevents it from doing damage. The blow-out magnet and secondary contact are in series with each other, but are connected in multiple with the main contact. Owing to their high resistance practically no current flows through them until the circuit through the main contact is opened, when they take the whole current, creating the magnetic field and extinguishing the arc independently and apart from the main contact.

The marked rating of a circuit breaker as 100-500 indicates the lowest current that will automatically open the circuit and the maximum normal current carrying capacity. The circuit breaker is set to open at any desired current from its lowest rating to 50 per cent. in excess of its highest rating, by adjusting the calibrating spring of the tripping armature. An indicator on the adjusting stud registers with well spaced marks on a brass scale, showing the current at which the circuit will be opened.

The handle of the form L circuit breaker is removable, but is automatically locked in place so long as the circuit remains closed. It can be removed only when the circuit breaker is open. Moreover, when the handle is removed the circuit breaker cannot be closed. This interlocking device allows feeder circuits to be kept open at the will of a single operator, avoiding to a large extent any accidental closing.

Although automatic in action and capable of carrying safely the currents within their rating, and of opening the circuits on heavy overloads and short circuits, circuit breakers should be given a reasonable amount of care and attention to insure satisfaction with continued use. By regarding this injunction the life will be very much prolonged.

Diplomatic Complications over Foreign Cables.

The French embassy at Washington is actively assisting the French Telegraphic company in the efforts it is making to lay a new cable from Brest, France, to Cape Cod, Mass., to take the place of the old one laid 18 years ago. The attention of the senators has been called to the restrictions which a pending Senate bill will place on the French company. This bill prohibits the landing of new cables without the previous consent of Congress, and it is said to be directed mainly against the French company. The cable has been partly laid, and it is said that the care requisite in laying a cable makes it necessary to take advantage of the coming summer weather in order to make the landing at Cape Cod. The French company has submitted a protest to the Senate committee on commerce, and a strong intimation has been made to senators from French official sources that if entrance to this country is denied there will be a strong probability of retaliation by the French government against the four American cable companies entering France.

The point is also urged that the cable line to France would be of important military and strategic importance to this country in the event of trouble between the United States and Great Britain, as all other transatlantic cable lines pass over British territory. The statement presented to the Senate commerce committee points out that the French government is a friendly republic; that 4,000 American pupils are receiving their education free at the government schools in France; that as France has never discriminated against American companies, Congress should guard against legislation "which may be considered by the French Republic as injurious to the interests of its people."

Mr. Blaine, when secretary of state, took decided grounds against allowing foreign companies to land cables in this country without permission. In the course of the present controversy it has been said that if the French company attempted to land its cable at Cape Cod the State Department would interpose force, if necessary, to prevent the landing.

Another phase of the subject is its bearing upon a proposed new German cable company. It is said that the Senate bill is aimed at the German rather than the French company, and is in some measure intended as retaliation for the restrictions imposed on American life insurance companies in Germany.

One Explanation of the Origin of the "Philadelphia Schedule."

[From the *Chicago Record*.]

A few years ago the city of Philadelphia, after a great deal of calculation, figured out the number of hours of bright moonlight in a year and just when this moonlight came. Contracts for lighting the streets were made with the proviso that not all of the street lamps need be in use when there was bright moonlight. By following this schedule the city was enabled to save money.

The "Philadelphia schedule" was adopted by many cities and towns. Suppose a town to be in total darkness on a rainy night. The citizens would naturally complain. Then the president of the company which had the contract for lighting the streets would produce the "Philadelphia schedule." He would show that, according to this schedule, the moon was shining in Philadelphia, and so there was no need of lighting the street lamps.

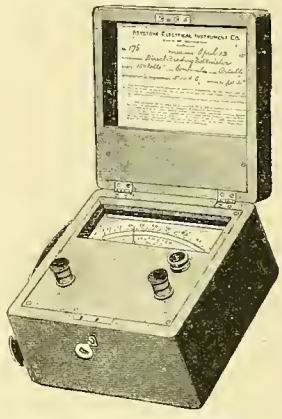
Keystone Portable Voltmeters.

The Keystone Electrical Instrument company of Philadelphia announces that it is now prepared to offer a complete line of portable voltmeters for combined use on direct and alternating current.

This line of voltmeters is the result of a large number of experiments covering several years, followed by time tests in actual practice; therefore the company feels that it is warranted in coming before the public with the statement that its portable voltmeters meet more fully than any similar line on the market the requirements of practical use under all conditions.

In the construction of these voltmeters nothing is incorporated which is subject to change or deterioration, and having been calibrated from absolute standards of voltage, they may be relied upon to maintain their accuracy. The system is such that there is no magnetic lag nor any error due to self-induction, therefore they are independent of frequency variations on the alternating current. They are mounted in highly polished mahogany cases, with key, lock and leather carrying handle. With each instrument is included a pair of flexible leads, for which a special compartment is provided.

Two features are incorporated which busy users will appreciate. One is that the instruments are dead-beat without the use of a mechanical brake, and the second is that each instrument is provided with a switch for reversing the direction of the current flow through the voltmeter when used on direct current circuits. This



KEYSTONE PORTABLE VOLTMETERS.

latter enables the user to obtain mean readings easily and promptly, and further, by turning the switch to the dead-point, to throw the instrument out of circuit without disconnecting the leads.

These voltmeters are listed in ranges from 12 to 700 volts, single and double scales, so that all classes of testing work are provided for.

Accumulator Traction Trials on Belgian Railroads.

An experiment in electric traction is about to be made on the Belgian state railway line, nine miles in length, extending from Brussels to Tervueren. According to *L'Electricien*, five large accumulator cars will be operated in addition to the present steam service. They are to run at a speed of 18½ miles an hour on the steepest gradient—1 6 per cent.—and at 31 miles an hour on other parts of the line. Each car will be 52½ feet long, and there will be room for 80 passengers. There are two motors on each car. The motors will weigh from eight to nine tons, the cells 12 tons, the other electrical apparatus one ton and the car 20 tons. Three Julien and two Tudor batteries have been ordered, each of 264 cells. The former are designed to make three or perhaps four journeys without recharging, the latter only one journey. In the latter case, however, the time required for charging is limited to one hour, while for the Julien battery six hours are required. The cells are in 24 drawers, 11 being contained in an ebonite box in each drawer. The following-named firms are supplying motors for these trials: Jaspar of Liége, Pieper of Liége, Schuckert of Nuremberg and Thury of Geneva. The motors will be compound wound. The cells will be charged by a Willans engine and dynamo, erected on a car drawn by an old locomotive.

Those who were interested in the problem worked out by H. Russell Smith in his electro-magnetic elevator (described at length in the WESTERN ELECTRICIAN of December 19, 1896) will be glad to learn that the principle is to be tested by practical operation on a large scale. A vacant shaft has been secured, and a large-sized machine, complete in all its details, will be installed. This elevator will probably be running in six weeks.

Electric Lighting in British Guiana.[1]

By Samuel Vyle.

Georgetown, British Guiana, has always been fairly up-to date in taking advantage of new enterprises calculated to be of benefit to its inhabitants. Thus in 1870 the gas company was established, and seven years later the tramways commenced running. Telegrams with free addresses were reduced to sixpence long before the mother country was so benefited; and since 1890 a day and night telephone service has been provided for the low sum of 50s. a year. The town also enjoys a half-penny letter rate within its municipal boundaries, a boon yet to be conferred on the cities and towns of England.

As an evidence of the enterprise of the sugar planters of the colony, it is a fact that a number of electric lighting plants had been imported and erected on sugar estates before anything practical was done in Georgetown, its capital. It is true, however, there had been much talk and considerable correspondence with English and American firms up to 1889; and the Town Council, when renewing the street lighting contract with the gas company, insisted upon inserting a clause reserving to itself the right to experiment with 50 lamps if they so desired. Nothing, however, was done till April, 1890, when Jacob Conrad, a town councillor and merchant of standing, formed and registered the British Guiana Electric Lighting & Power company, limited. Being elected chairman, he practically became its manager and financier, and as such he ordered from the Thomson-Houston Electric company of the United States an experimental plant sufficient to illustrate both arc and incandescent lighting, requesting that a competent electrical engineer be sent to erect and work the same.

In the summer following William Rutherford, a young Scotchman, who had gone to America and been trained in the Thomson-Houston workshops, arrived in Demerara with the necessary plant, which comprised a McIntosh & Seymour fast-speed 20 horse power steam engine with suitable boiler, a direct current dynamo for nine 1,200 candle power arc lamps, and an incandescent machine for 100 sixteen candle power lamps.

Whilst a site for the station was being sought after, negotiations were opened with the Town Council, which resulted in an agreement to light the area occupied by 50 gas lamps in a central part of the town. Having secured a suitable piece of land near the railway goods depot, building operations were commenced. The material used was wood upon brick foundations, and, under the energetic supervision of Mr. Conrad, the work speedily progressed, until an imposing structure proclaimed the future home of the electric light. The building was spacious enough to contain the experimental plant, with ample room for the early additions hoped for. The upper floor was devoted to stores of various kinds, and a couple of rooms was furnished by the company for the use of the electrical engineer.

Concurrent with the laying down of the steam and electrical plant within the building, Mr. Rutherford also commenced and carried on the outdoor work, permission having been obtained to erect poles and run overhead wires. The latter were insulated in the usual way—more as a concession to public opinion than of great insulating value. The poles were of colony wood, averaging 30 feet in height, but rising to 35 feet where roads were crossed, and placed 40 yards apart. The cross arms were of large scantling, and instead of being bolted to the poles, as is the English rule, were secured by two large iron spikes. The insulators used, with the exception of a few Benoett porcelain, were of green glass (screwed to wooden pins), the kind so largely used in America, and not to be compared for insulating properties to the white double-shed porcelain, used on all the government telegraph and telephone lines of the Colony. But being part of the "equipment" sent from America they were used, and not only so, but orders for them were repeated in all subsequent extensions, with the exception that iron took the place of wood for the pins, which, on account of the excessive heat and damp, soon rot. No attempt was made to secure these insulator pins to the arm by nuts, and the wires were bound to the insulators by strips of the same material.

The area selected for the trial was about half a mile along the high or main street, in front of the law courts and town hall; and it also embraced the block containing the residence of the governor, and known as "Government House." This section was ready for lighting by the end of the year, but had to wait for some fittings until January 17, 1891, when Lady Gormanston, wife of the then governor, formally started the light amidst a brilliant company which had been invited to witness the ceremony. The streets were crowded by an expectant mass of people—mostly blacks and coolies. The arc lamps especially came in for attention, one old lady loudly demanding to know who "struck de match" which lit the lamp nearest to her.

The experiment was considered so successful that the Town Council soon after entered into a contract with the company for lighting about one-half of the streets of the town with electricity—partly arc and partly incandescent of 25 candle power. New machinery, wire and appliances for so large an extension had to be ordered at once, and its erection made a busy time of it for the electrical engineer.

In order to show the suitability of the new light for private houses, the chairman of the company had his own residence fitted up; and when it was seen that the heaviest breeze could not blow out the incandescent lamp, its success was assured, as the cool galleries or open verandahs of the houses are the resort of all who desire comfort in a tropical climate. The long evenings induce much reading; and the luxurious way of doing this is to swing in your hammock with the electric light over your shoulder.

At present fully one-half of the residential part of the town enjoys the electric light, and the clubs and hotels (with special fittings for billiard tables), as well as the stores generally, have taken kindly to it. The postmaster-general was the first official to install it, and since then the Customs have adopted it for their large bonded warehouses. The "Court of Policy," or local House of Parliament, has been so fitted, while the almshouse (the gentle term for English "workhouse") and large police barracks are thus equipped. Nor does it stop there, for the new Anglican cathedral has been fitted with special arc and incandescent lamps, while that of the Roman Catholic persuasion is confined to using incandescent lamps of 50, 75 and 100 candle power. Some of the smaller churches and schools belonging to the Wesleyan denomination are so equipped, while more recently the present governor (Sir W. A. L. Hemming, K. C. M. G.) has had his residence completely fitted up, where only two or three lights were before. It will thus be seen that the electric light has come to stay, and the supplying of a single 16 candle power light for $1 per month—including renewals—is largely taken advantage of by those occupying bachelor apartments and lodgings.

The alternating current is at a voltage of over 1,000 at the station, but reduced to 52 volts at the transformer, usually affixed to the pole nearest the place to be supplied.

At the station the whole of the wires are carried to an open framework and neatly attached for testing purposes, where all needful apparatus is ready to hand for that duty. The lightning protector for both wires and dynamos is the Thomson-Houston special form. But lightning is not very dangerous in Georgetown, and only one transformer has been damaged.

In 1894-5 the capital of the company was increased from $50,000 to $250,000, when a large further extension of the company's plant was made, to meet the growing demand for current. The work was ably carried out by Arthur Shaw, with the assistance of Ernest L. Simpson, the present engineer and manager, who succeeded him, and is at present in charge.

Financially, the company has had uphill work from the first, as the investing public did not so readily catch on, as to the more fascinating gold mining shares. Now, however, that it has, at its last meeting in July, declared a dividend of six per cent. on its ordinary shares, it may be looked upon as on the highway to success; and economically worked, it should be so, seeing they are allowed by ordinance (Colonial Act of Parliament) to charge 30 cents, or 1s. 3d. per unit for current, though the price charged from the commencement has only been 25 cents, or 1s. 0½d., which corresponds as nearly as can be to the price of gas, viz., 14s. 7d. per thousand. Coal costs from 25s. to 33s. per ton. The present chairman is the Hon. Arthur Weber, a member of the Court of Policy, and there are several other M. (C.) P.'s on the directorate.

1. From the London *Electrician*.

Spring-suspended Railway Motors.

An interesting patent interference case will be argued in the Patent Office on the 5th of May. The controversy is between the General Electric company, represented by Geo. R. Blodgett and T. J. Johnston, and the Walker company, for whom Brown & Darby are attorneys, and relates to the control of the spring suspension motor which has become so popular of recent years and which the City Railway company of this city is using. A former interference was fought out between the same parties, the General Electric company resting its claim upon an alleged invention by Elmer A. Sperry, but the Patent Office decided in favor of the claim of the Walker company. Subsequently the General Electric company filed a claim based upon an invention of Walter H. Knight, the former head of its electric railway department. A large mass of testimony has been taken, and the Walker company feels confident of another favorable decision. Whoever obtains the decision will have a broad patent on the spring suspension motor now in use.

Milwaukee Bonds in Question.

The public debt commissioners of Milwaukee have raised a question regarding the constitution of the state, which involves the validity of bonds issued by the city during the last year to the amount of several hundred thousand dollars. The constitution provides that no municipality shall issue bonds in excess of five per cent. of the valuation of all property therein, as assessed for county and state purposes. The officials of Milwaukee have taken the figures of the tax commissioner as a basis for the issuance of bonds, but it is now claimed that bonds cannot be issued in excess of five per cent. of the amount of the city's assessment as equalized for the purpose of levying the county and state taxes. If this contention is correct, bonds greatly in excess of the legal limit have been issued, and are consequently void. President Henry J. Baumgaertner of the Common Council says the effort to place a different construction on the law than that which has heretofore been the case is in the interest of the Milwaukee Electric Railway & Light company, which is opposed to the issuance of bonds for the purpose of establishing a municipal lighting plant.

Home Carbons Equal to Imported.

Word has just been received from Secretary J. S. Speer of the Partridge Carbon company to the effect that Manager James Partridge and himself have at last succeeded in manufacturing a new carbon for electric lighting that is fully equal to imported carbons. The production of this high-class carbon is looked upon by the company as such an important step that the management proposes to increase its capital stock and build a factory adapted for the manufacture of lighting carbons and push this business to its fullest extent. As is well known, the Partridge Carbon company has been doing a business almost exclusively in carbon brushes. Manager Partridge of the company is one of the oldest and most experienced practical carbon manufacturers in this country, and in addition to this in the early days of the carbon business he was one of the experts that went abroad to teach the carbon business on the other side of the water. For a number of years Mr. Partridge and Mr. Speer have been the practical men at the head of the Partridge Carbon company's works at Sandusky, and through their energetic efforts the Partridge motor and generator brushes have become known and well appreciated all over this country. From the fact that carbon manufacturers deem the production of a carbon equal to the imported article as a decided feat in manufacture, it would seem as though the Partridge company deserves congratulation.

CORRESPONDENCE.

New York Notes.

New York, April 24.—There is trouble on Staten Island between rival railway companies, the Staten Island Electric Railroad company and the Staten Island Midland Railroad company. On Wednesday the former company, better known as the "Syndicate," laid nearly 2,000 feet of track along South street, from the corner of Jay street, at St. George, over the private property of the Rapid Transit Railroad company and to the ground entrance of the new ferry house. This gives the "Syndicate" two entrances to the ferry house and preempts the route which the Midland company has spent many thousand dollars to secure. The first intimation that Staten Island residents and officials had of the purpose of the "Syndicate" was at eight o'clock in the morning, when a force of 150 laborers began digging up the street and loads of rails and ties arrived. The first objection to the work came from resident officials of the Staten Island Rapid Transit company, but the "Syndicate" officers displayed a formal legal consent signed by Vice-president King of the Baltimore & Ohio Railroad company, who was made president of the ferry company by a recent agreement. The work progressed without interruption until half-past ten o'clock, when County Engineer Henry P. Morrison appeared and ordered work stopped in that part of South street between Jay and Stuyvesant streets, which is under his jurisdiction. The "Syndicate" already has double tracks in that block, but had torn up a hundred feet of the roadway to lay the switches. His orders were not obeyed, so he summoned the police. Sergeant Cobb, with six policemen, soon arrived and arrested about 40 of the laborers. They were taken before Justice Acker, at New Brighton, and were paroled, when a stipulation was entered into by the representatives of the railroad company to disturb no more of the county road without consent. Meanwhile representatives of the Midland company had notified several of the New Brighton trustees and had sent lawyers for injunctions. Four of the trustees reached the scene of the work shortly after 11 o'clock, with Village Counsel Finch. They were shown that the "Syndicate" had been granted the right of way to the water's edge along South street in its original franchise, given in March, 1895. The "Syndicate" had a car upon the new track by two o'clock, and by night the entire line was in running shape from Jay street to the ferry house entrance.

The old Edison Electric Light company is the defendant in a suit now come to trial in which Col. W. Preston Hix seeks to recover $68,000 commission for organizing the Edison Electric Light company of Philadelphia. The colonel alleged that the Edison people gave him authority to organize the Philadelphia company, which is now paying dividends on a capital stock of

$2,000,000, with the understanding that he was to receive 10 of the 35 per cent. of stock which the New York company was to get. He failed to receive the stock. The defendant company denied that the colonel was the promoter of the Philadelphia company, alleging that the man who organized it was a Philadelphia capitalist. Judge Gildersleeve reserved his decision.

The Legislature has passed the bill authorizing the trustees of the New York and Brooklyn bridge to contract with any street railway or elevated railway companies to run their cars over the bridge, provided that no charge be made for passengers transported across the bridge in excess of the regular fare.

Judgment for $6,891 has been entered against the Scott Electric Lamp company, whose office was at No. 126 Liberty street, in favor of Eleanor C. Huntington, on two demand notes of the company, dated March 1st and 13th. The company manufactured an electric searchlight. It was incorporated in 1894 with a capital stock of $25,000, and succeeded to the business of the Scott Electrical Manufacturing company,

Even Hoboken is to have the advantages of electric traction. The ordinance granting to the North Hudson County Railway company the right to operate trolley cars in the streets of that town was signed on April 20th by Mayor Fagan. The Common Council passed the ordinance without demanding of the company any compensation. Before Mayor Fagan would sign the ordinance he sent a letter to President Myles Tierney of the company asking for certain concessions relating to the transfer of passengers from any of the lines in the city and the running of the cars on regular time. The company accepted the mayor's conditions.

The incline by which the trolley cars of the Long Island electric railroad are to be brought up to the level of the Kings County elevated road at the Grant street station is about completed. The station at Grant street is close to the Brooklyn city line, and the most easterly station on the Kings County road. The platform has been divided by a fence, and the elevated trains will make use of one side, while the trolley cars run from the other side. There has been some talk of coupling the trolley cars to the elevated trains and running them all the way to the bridge and ferry, but that will not be done at present, at all events. The electric railroad now runs to Jamaica, and plans have been formed for extending it to Lawrence and Far Rockaway in one direction and to Hempstead in another. In the direction of Hempstead it has been built as far as Queens, following the line of the Hempstead and Jamaica plank road. There seems to be some question whether it will be extended to Hempstead this summer. The Far Rockaway branch is well advanced, however, and only about a mile of track remains to be laid. In Jamaica the Long Island Electric Railway company intends to use the tracks of the Brooklyn Heights company for nearly half a mile. The running time of the cars from the terminus of the elevated road to Jamaica is 22 minutes.

M. S.

From Old Virginia.

RICHMOND, April 24.—Members of the City Council and other guests recently accepted the invitation of the Richmond Traction company to inspect its new line from First street to Hollywood Cemetery. The trip was begun at the City Hall and made in one of the summer cars. William M. Habliston, vice-president and general manager of the company, saw to the comfort of the guests, who expressed themselves as highly pleased with the new line, which gives rapid transportation to a large portion of the city. After the return to First street the party was taken through the car shed, which is a model of its kind. Connected with the shed are the repair and paint shops, where all work can be done by the company's employes. After the car shed had been thoroughly inspected, the car was boarded for a run through the city to the power house. On the Broad street hill the emergency brake was tested, stopping the car with very little jar within a few feet. At the power house there are two Corliss engines geared directly to 450 horse power dynamos. One of these is held in reserve for emergencies. After the party had viewed the power house to its satisfaction lunch was served.

At a recent meeting of the committee on streets, held at the city hall, a petition was presented from the Richmond Railway & Electric company asking permission to extend this road from the Hermitage road via Broad and Lombard streets, to connect with the Main street line. The petition was referred to a committee of five. The same committe has the application of the Traction company before it, for building a road from Broad to Cary street via Lombard street.

The granting of a franchise to the American Long-distance Telephone company has excited great interest in Norfolk. The Common Council has passed the ordinance, which is a very rigid one, but the select body has been deluged with petitions against the franchise, because the company declined to fix a maximum rate. The matter is still in abeyance.

The street committee of Portsmouth, Va., to which has been referred the application of the Port Norfolk Electric Railway company for the use of certain streets, has recommended that the railway company be allowed to run its tracks on Middle street to South, to Washington, to Harrison, to Fifth, to Henry, to First, and that the company pay $20 for each street that it uses and deposit a certified check for $1,000 to the credit of the city of Portsmouth, to be forfeited if it fail to complete the road in six months' time. The report of the committee has been adopted, and the city attorney has been directed to prepare the contract as speedily as possible.

The Common Council of Alexandria has ordered that the Washington, Alexandria & Mount Vernon Electric Railroad company attach fenders to the front of each train or car run through the streets, similar to those used by the company in Washington.

A large force of men has been put to work in Hampton, Va., by Superintendent W. Darling on the large extension of the power house of the Hampton, Newport News & Old Point railway. The building will be enlarged to about twice its present size, and will occupy a block on Armistead avenue. New cars are expected shortly and an excellent car service may be expected.

The First Baptist Church at Bristol, Va., is being wired by the Bristol Gas & Electric company, which will supply the building with 40 incandescent lights.

T. I. P.

Northwestern Notations.

MINNEAPOLIS, April 24.—The Board of Fire Commissioners of St. Paul has authorized the appointment of an electrical inspector, who is to pass an examination before a committee consisting of a representative of the Edison Electric company, the Northwestern Telephone Exchange and W. H. Merrill, Jr., of Chicago, representing the insurance companies.

The city electrician of Dubuque, Iowa, in his annual report says that there are 25 miles of electric street railway wire and a total of electric wires of all kinds of 870 miles.

The La Crosse Department company of La Crosse, Wis., has sued the Edison Light & Power company to recover $53,675 for loss sustained in a fire in its store in December, 1894, when the entire stock was burned. The plaintiff alleges that the defendant did not do the wiring properly.

The Bowdle, S. D, Electric Light company has been incorporated with $5,000 capital stock. H. D. Baillet, W. W. Brant, A. F. Le Claire and A. L. Yeaton are the incorporators.

The annual meeting of the Winona, Minn., Street Railway & Electric Light company was held in Boston, Mass., resulting in the election of the following-named officers: President, Arthur Perry; vice president, R. T. Payne; secretary and treasurer, Allison Burr; general manager, S. B. Livermore. The last-named is the only one re-elected, the other officials being all lawyers of St. Paul who represented the eastern capitalists, it is supposed.

The Postal Telegraph company has asked permission in Des Moines, Iowa, to set up electric clocks at various points in the city.

The Ottumwa, Iowa, Electric & Steam company contemplates extending the street railway system.

The Chippewa Valley Electric Railway company has ordered new cars, etc., for rebuilding its system in Eau Claire, Wis.

An electric lighting plant will be put in the agricultural college at Brookings, S. D.

A franchise for electric lighting has been granted to Charles F. Freehauf of West Union, Iowa.

A resolution has been introduced in the Minneapolis City Council instructing the city engineer to prepare plans and specifications for a municipal electric light plant.

City Engineer Huber of Spokane, Wash., estimates the cost of an electric light plant at $32,000.

The Fort Wayne Electric corporation secured the contract to furnish the electric equipment for the municipal plant at Gladstone, Mich. The old company, which has been burned out twice within a very short time, has decided to rebuild.

An electric light plant is projected for Brooklyn, Ia., and it will be established if 500 lights are taken.

L. A. McConnell has been appointed manager of the Western Union office at Clinton, Ia.

H. W. Winslow was granted a franchise for electric lighting at Rockford, Iowa.

Work has been begun on the electric light plant at Sturgis, S. D.

Walter B. Sanford, owner of the Pipestone, Minn., electric light plant, has assigned to W. C. Briggs and J. R. Hubbard.

The Minneapolis Street Railway company is expected to extend its Camden Place line seven blocks soon.

E. C. Baird is securing subscriptions for electric lighting at Graceville, Minn., with a view to establishing a plant.

Wm. Nopper is an applicant for an electric light franchise at Lansing, Ia.

The Twin City Rapid Transit company carried 41,232,149 passengers in 1896, and the cars made a mileage of 11,015,938. Improvements costing $300,000 were made, and the gross receipts were $2,059,217.57, an increase of over 3½ per cent. over the preceding year. The company has made heroic efforts, and has been successful, on the Minneapolis end at least, to keep the lines all open through the severe snowstorms which have prevailed the last winter. The company's expenses for fighting snowstorms the past winter are said to have exceeded those of the three preceding winters.

The Council of Stillwater, Minn., has passed a resolution ordering the owners of the street-railway system to operate the plant.

The Citizen's Traction company of Oskosh, Wis., has raised $200,000 on a first mortgage on its plant to the New York Security & Trust company. It is signed by J. K. Tillotson as secretary of the Citizens' Traction company. Tillotson has been endeavoring for years to establish an electric railway in Oshkosh, and the company now has the steam plant in, cars purchased, and this successful bond issue seems to indicate that he is to be successful at last.

It is understood that John McKinley of New York and J. W. Edwards of Winneconne, Wis., are behind the projected electric railway to run between Stevens Point and Oshkosh, Wis. Rumors have been made of this line for some time past, but this is the first mention of anyone interested. A survey is to be made at once and the available water powers inspected. If plenty of cheap power is found, the line will be electric, otherwise steam will be used.

Citizens of Breckenridge, Minn., are investigating the cost of an electric light plant. The light is now received from the Wahpeton, N. D., plant, across the river, and they think they are paying too much.

The Appleton Electric Light & Power company of Appleton, Wis, has absorbed the Citizens' Electric Light company, the purchase price being $25,000. Both companies have been engaged in a vigorous price-cutting war and neither has been able to make anything. A few days since, it is learned, each company made a proposition to sell to the other.

The City Council of Eau Claire, Wis., has granted a 30-year franchise to the Chippewa Valley Electric Railway company, which will rebuild the present street-car system and extend it.

C.

PERSONAL.

J. S. Tebbets, formerly manager of the Chicago agency of the Westinghouse Electric & Manufacturing company, and now of Duquesne, Ariz., was a Chicago visitor last week.

Announcement is made of the marriage of Edo E. Mercelis to Miss Jean Agnes Van Antwerp in Albany, N. Y., on April 21st. Mr. Mercelis is a leading attorney in the city of New York, and is well known to the electrical fraternity.

The following-named out-of-town gentlemen registered at the New York headquarters of the National Electric Light association last week: W. E. Clark, Boston, Mass.; Chas. R. Huntley, Buffalo, N. Y.; L. B. Stillwell, Pittsburg, Pa.

The funeral of Mrs. Clowry at Omaha on April 21st was most impressive. There was a very large attendance of telegraphic and other friends, and the tribute of flowers was beautiful and elaborate. The music was touchingly rendered, one of the selections being "Resignation," composed by Mrs. Clowry.

Friends of William M. Brooke, the representative of the Central Electric company in Texas, will be glad to learn of the unusual mark of distinction conferred upon

him by the Texas Gas & Electric Light association at its recent meeting in San Antonio, Texas. Mr. Goldrick of the San Antonio Gas & Electric Light company, on behalf of the Texas Gas and Electric Light association, presented Mr. Brooke a handsome gold medal, inscribed "The most popular lighting man in Texas." Mr. Brooke's career in the electrical business began in the fall of 1893, when he identified himself with the Central Electric company in a subordinate capacity. The management was quick to recognize Mr. Brooke's qualifications; his progress therefore was very rapid, his experience as a salesman in other lines being quickly adapted to the intricacies of the electrical supply trade. In 1894 Mr. Brooke was given full charge of the southwestern territory, with headquarters in New Orleans. The wisdom of placing this important territory in Mr. Brooke's hands is evidenced by the action of the Texas Gas and Electric Light association, and justifies the judgment of the Central Electric company in appointing him its representative in the territory mentioned.

ELECTRIC LIGHTING.

It is said that Brussels has simply gone wild over the project of converting itself into a seaport. Not only the people, but the authorities as well, seem to take it for granted that the moment the ship canal connecting the city with the coast is open to navigation all maritime traffic will at once abandon the port of Antwerp for the capital. To such a degree, indeed, have the citizens of Brussels lost their heads that the Municipal Council has passed a resolution for the construction of a huge electric light-house in the center of the city on the Place de Brouckere, to serve as a beacon to ocean steamers, as well as for an ornament to the city.

ELECTRIC RAILWAYS.

The company operating the Youngstown & Lewiston road is building an extension to the proposed new summer resort to be known as Rumsey's Grove, on the shore of Lake Ontario, adjoining the military reserve at Fort Niagara.

The vice-president of the Rochester, N. Y., Railway company has issued an order allowing one bicycle to be carried in the front vestibule or front platform of the cars of that city when the wheel or its rider has been injured. Double fare will be charged, both for the wheel and its rider.

The Lyons & Chicago Railroad company has been incorporated with a capital stock of $100,000. The object of the company is to construct and operate a railroad from Lemont to Chicago. The offices of the company will be in Chicago. The incorporators are F. R. Knowlton, R. Shearson, F. F. Parates, S. S. Casac and Mark Budson, Jr., of Chicago.

The Liberty & Jeffersonville Electric Railway company has been incorporated in New York state with a capital stock of $120,000 to operate a line of railroad from Liberty to Jeffersonville, in Sullivan county. The directors are Frank Lober, Wilhelmina Lober, Minnie Lober, Kate Lober, Louise Lober and Thomas M. Loomis of New York city, and Charles W. Wilfert, Charles Haines and George Yager of Jeffersonville.

Last month the trustees of the village of Penn Yan, N. Y., had several meetings to consider the question of granting the electric railroad company a franchise to operate on Jacob street in that village. The franchise was finally granted on the night of April 21st. The company has agreed not to run freight cars through the streets of the village between the hours of 9 A. M. and 5 P. M. Contracts have already been let for the rails and necessary machinery, and the ties and poles will be purchased at once.

The Buffalo, Niagara River & Grand Island Railway company of Buffalo was incorporated April 12th, with a capital stock of $30,000. The company will operate a street surface electric railroad from O'Neil and Tonawanda streets, at the Buffalo city line, to the dock of the Buffalo and Grand Island Ferry on the Niagara River, in the town of Tonawanda. A branch will extend along the river road to the proposed location of the Grand Island bridge. The directors are Herbert P. Bissell, J. Henry Metcalf, Donato A. Crage, George A. Ricker and others of Buffalo.

The Metropolitan Railway company of Louisville, which was recently incorporated, has submitted to Mayor Todd an ordinance in which it offers $75,000 a year for the street car privileges of Louisville. The charter of the Louisville Railway company, which operates all the street car lines, will expire on September 28th of this year. The Metropolitan company offers $75,000 a year for the period of 20 years. The company also binds itself to place conductors on every street car, to heat them in winter, to charge no higher rate of fare than four cents a trip, and sell eight tickets for 25 cents.

The Rochester, N. Y., Railway company has gone into court asking to be relieved from taxation on its personal property. For many years past the company has been assessed for its personal property on a valuation of $880,000, but representations were made, on behalf of the company, of such a character, before the assessors, when allegations were heard this year, that they were induced to reduce the assessment to $700,000, a reduction of $180,000, but this was not satisfactory to the company, which has now gone into the courts to secure relief from the payment of any and all personal tax on the ground that its stock is of no value other than that it derives from confidence in its management and the expectations of greater earnings in the future by extensions of its lines and increased value of its franchise. The Rochester general city tax this year is $16.18 on each $1,000 of assessed valuation, and if the street railway company is successful in its contention it will result in a gain to the company of about $11,300. The reduction of $180,000 granted by the assessors effected a saving of about $3,000 to the company. Under the valuation of last year, and with the then higher rate of taxation, the company paid about $18,000 of personal tax. Justice Werner has granted a writ of certiorari, returnable May 1st, and the outcome of the case is being watched with much interest.

TELEGRAPH.

The proposed international chess match by cable between members of the House of Representatives at Washington and members of the House of Commons at London will illustrate the possibilities of electrical communication between the two continents. A play can be communicated to London and a reply received in Washington in three minutes, it is said.

Reminders of the foreign troubles are found in the bulletins issued by the Commercial Cable company. The Austrian administration announces that in consequence of the outbreak of war between Greece and Turkey messages for Turkey cannot be transmitted via the Trieste-Corfu cable, but only via Bosnia, Montenegro or Servia. The Turkish administration announces that by the decision of the imperial government exchange of messages in secret language for Greek minister and consuls in Turkey is forbidden. Messages should be written in plain language. Code and cipher are not admitted in private messages for Turkey.

The Overland telegraph line, which connects England with the Indian Empire, passes through Persia and has recently been subjected to an interruption of a quite serious character, due to the fanaticism of the populace. It seems that there has been a terrible drouth, which the subjects of the shah ascribed to the telegraph poles, and, above all, to the posts and signs of the survey department of the company. Accordingly all the obnoxious poles, wires and survey signs were destroyed by a priest-led mob. Heavy rain fell immediately afterward, and now, in spite of the severe punishment inflicted by the Teheran government upon the ringleaders, the masses of the population throughout Persia are firmly convinced that telegraph and survey posts are productive of drouth and inventions of the devil.

MISCELLANEOUS.

The *Railway Review* of Chicago has amplified its title, and is now the *Railway and Engineering Review*.

The corner stone of the fine arch which is to mark the main entrance to the grounds of the Trans-Mississippi and International Exposition at Omaha was laid on April 22d with imposing ceremonies.

A bill is before Congress for the appropriation of $750,000 for the adequate representation of the United States at the Paris Exposition of 1900. Col. George R. Davis, director-general for the government at the World's Fair, is said to be a candidate for the position of United States commissioner.

Northwestern University at Evanston is a co-educational institution, and the authorities exercise a strict supervision over the social dissipations of the students in the "fem sem." A new rule is that the girls shall not attend more than two evening parties a week, returning on these occasions not later than 11 P. M. To "keep tab" on violations of this rule it is said that an electrical recording device has been attached to the main street door of the Woman's Hall, so arranged and connected that a record is made in the dean's room every time the door is opened after the hour named.

The *Financial Chronicle* gives the following figures as the earnings of street railroads for the year ended December 31, 1896: The gross earnings of all the roads of New York city last year was $23,390,000; Boston, $9,763,000; Philadelphia, $10,787,000; Baltimore, $2,702,000; Chicago, $14,900,000; Pittsburg, $3,911,000; St. Louis, $2,209,000; Cleveland, $2,795,000; New Orleans, $1,334,000; Kansas City, $1,773,000; Minneapolis and St. Paul, $2,057,000; Buffalo, $1,884,000; Rochester, $889,000; Detroit, $1,704,000; Denver, $724,000; Des Moines, $240,000; Louisville, $1,235,000; Galveston, $213,000; New Haven, $809,000; Hartford, $637,000; Worcester, $636,000.

A break in the cable laid between the Senegal coast of Africa and Pernambuco in Brazil five years ago has led to a discovery related recently by Mr. Benest to the Institution of Electrical Engineers. The cable was as fine a one as modern methods could devise, yet after three months it broke about 150 miles from the African coast; it was repaired and broke again. It was then found that at the place where the break occurred there was a great deal of vegetable growth resembling river weed; that the color of the sea was a dirty brownish green, indicating the presence of fresh water, and birds' feathers, pieces of orange peel, scraps of carpet and bits of driftwood were drawn from the bottom of the ocean. The phenomenon was purely local, as the nearest river was 75 miles away and discharged its waters in a different direction. It was surmised that it meant the sudden breaking through of a submarine river, and the cable was moved to a distance; after two years it broke again and was moved once more, and engineers are waiting to see what will happen. Submarine rivers are known to exist in other parts of the ocean, off the mouth of the Congo and in the Gulf of Carpentaria, for instance. This explanation, however, does not account for the carpet and the orange peel.

Consul Germain of Zurich has sent the following note to the State Department: Diamonds of a very small size have been produced artificially heretofore, but no one has as yet succeeded in producing large ones. E. Moyat claims to have discovered a new process by which to produce diamonds of large dimensions. In principle, his process is about the same as the one already invented by others, and that is to obtain crystallized carbon out of iron and coal by means of high pressure and high temperature. Yet there is some improvement in the Moyat process as regards the technical operation. Pulverized coal, iron chips and liquid carbonic acid are placed in a steel tube and hermetically sealed. The contents are then subjected to the action of an electric arc light by means of two electrodes introduced into the tube. The iron liquefies, is then saturated by part of the pulverized coal; at the same time the liquid carbonic acid evaporates, thereby creating an enormous pressure on the mixture of iron and coal. This pressure again considerably increases the dissolution of the coal in the liquid iron. While the mixture is cooling, the carbon crystallizes, partly in form of real diamonds and partly in the form of similar stones. These crystals are then segregated by dissolving the iron in diluted muriatic acid. The mixture by the above method remains under high pressure during the operation of the electric current, while by other methods the pressure is obtained later on only by means of the rapid cooling process of the crucible.

TRADE NEWS.

The Bi-metallic Electric Transmission company has removed its offices to 121 Liberty street, New York.

By an arrangement with the Standard Paint company of New York, the Electric Appliance company will carry a large stock of P & B insulating products in Chicago. Western orders may thus be filled promptly from stock.

B. C. Kenyon, manager of sales of the Diehl Manufacturing company, Elizabethport, N. J., was in Chicago recently. Mr. Kenyon is about to return home after a 10 weeks' trip throughout the central, western and southern states, where he visited all the principal cities. Mr. Kenyon has nothing but flattering reports to make, having met with excellent results in almost every town visited. He claims that nearly 80 per cent. of the central station companies handle the Diehl fans, and further states that the fan business of the Diehl company has already increased 50 per cent. over that of last year. This is certainly a fine showing and one which speaks for itself. It might be mentioned that this is the first extensive trip made by a representative of the Diehl company, and the company is certainly to be congratulated in having such an efficient salesman as Mr. Kenyon.

The new catalogue of ceiling fans which has been recently published by the Hunter Fan & Motor company, Fulton, N. Y., is, as is usual with this company, a concise and well illustrated pamphlet embodying all of the points which would seem to be important to a prospective purchaser. The company also issues a special catalogue of rotary and exhaust ventilating fans, showing the many useful applications of this apparatus. General Manager J. C. Hunter reports that the business thus far this season has been far in excess of that of last year, and the prospects are decidedly encouraging for a large trade. Duplicate orders are being received for fans already delivered, and the Hunter company is also receiving large orders from those who tested the fans last year, one large order from Florida being received, where the fans had been in operation nearly every day, and had not cost a dollar for repairs.

BUSINESS.

The increasing demand for the Garlock Packing company's specialties has made it necessary for the company to open an office in Cleveland.

The Electric Appliance company is introducing a new electrical soldering iron, which it is ready to guarantee as an electrical and commercial success. A reliable electrical soldering iron has been a difficult device to manufacture, and a number of failures are on record. The Electric Appliance company has given its new iron an extensive test, and stands ready to guarantee the result.

The General Electric company has received an order for several hundred alternating current induction motors, to be used to operate the Tuerk ceiling fan, manufactured by the Hunter Fan & Motor company of Fulton, N. Y. This is a high endorsement of the alternating current induction motor, inasmuch as hundreds of these motors were used last year for operating Tuerk ceiling fans, to the entire satisfaction of the Hunter company.

The electrical fraternity will doubtless be pleased to learn that A. W. Kilbourne has recently closed a contract with the Ohio Storage Battery company, which places in his hands the general sales agency for this company. Mr. Kilbourne's wide acquaintance with the trade will unquestionably enable him to push Ohio storage batteries with success. The company is bringing out a new cell built on original lines, which, it is claimed, will beat anything in the market for lightness and at the same time be low in cost. Mr. Kilbourne's office is located in room 59 Wade building, Cleveland, Ohio.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued April 20, 1897.

580,851. Magneto Telephone. Leonard E. Dye, Morris, Mion. Application filed May 27, 1896.

In a magneto telephone there is the combination with the box and the vibratory diaphragm therein of an upright permanent magnet supported within the box and comprising a pair of different sized horseshoe magnets arranged parallel and one within the other, parallel extension pole-pieces fitted between the adjacent poles of the two magnets, induction helices or coils encircling the pole-pieces at one side of the permaneot magnet, the armature connected with the diaphragm and balancing strings connected with the armature.

580,853. Telephone Switchboard. Charles E. Egan, Chicago, Ill. Application filed December 5, 1896.

A switchboard for telephone stations is provided with stationary jacks or plug-sockets, and spring-arms at opposite sides of the jacks having their free ends projecting in front of the board, with contact points in the path of the arms, whereby the operator is enabled, by moving one or the other of the arms, to close and open the circuits at will.

580,889. Armature for Dynamo-electric Machines. Albert L. Parcelle, Boston, Mass. Application filed October 9, 1893.

This armature consists of a laminated core; a supporting frame engages the periphery of the core and coils on the core, the portions of the periphery of the core between the engaging portions of the frame equaling in length the length of the inner circumference of the core, whereby the use of the wedges or blocks between the coils is obviated.

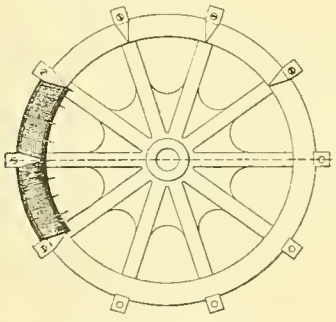
580,919. Method of and Apparatus for Disinfecting and Deodorizing. Albert E. Woolf, New York, N. Y. Application filed April 19, 1894.

The method of disinfecting and deodorizing described consists in discharging or injecting into a stream of infected water or sewage an electrolyzed solution of salt water.

580,927. Fire Alarm System. Charles E. Buell, North Plainfield, N. J. Application filed April 29, 1884.

A thermostat comprising a circuit controller that is held to close a circuit by a fusible substance, and when acted upon by heat opens the circuit and then closes the circuit.

580,929. Interlocking Switch for Theater Dimmers. George L. Colgate, Westfield, N. J. Application filed November 16, 1896.



NO. 580,889.

The combination includes a series of variable artificial resistances, a series of contact-points for each resistance, a series of independently movable switch-arms, one for each resistance, a rotatable shaft upon which the series of switch-arms is mounted, and means at each switch-arm for locking and unlocking it with respect to the shaft.

580,931. Electric Selling Device. Alexander Davidson, New York, N. Y., and Charles G. Armstrong, Chicago, Ill. Application filed January 25, 1896.

A device for selling tickets at a number of different stations and automatically indicating to all the remote stations the sale of any ticket at any station; each station having an annunciator with individual ticket-holders, a commutating device and a common synchronizing mechanism, the stations being electrically connected for perfect synchronism between the commutators of the stations, and for reciprocal action between the annunciators and ticket-holders of the different stations.

580,977. Sectional Armature for Dynamos and Electric Motors. George L. Jeck, Nashville, Tenn. Application filed January 9, 1897.

The claim is given: An interchangeable armature for dynamos and motors, comprising the non-magnetic metallic spider, the washers, the laminated core and the binding bolts and nuts, the washers and laminated core being formed with longitudinal aligned dove-tail grooves in combination with the interchangeable armature section formed with the longitudinal dove-tail tongue adapted to be removably secured in the dove-tail grooves.

580,987. Oscillating Interrupter. Daniel M. Moore, Newark, N. J. Application filed December 3, 1895.

In an interrupter, the combination with the oscillating member capable of vibration in different planes, of a ring or encircling contact member.

580,988. Interrupter. Daniel M. Moore, Newark, N. J. Application filed December 3, 1895.

An interrupter is working in a sealed receptacle, and an electro-magnet exterior thereto; a polarized armature is carried by the interrupter, and a source of alternating currents is provided with which the magnet is connected through a circuit independent of that including contacts of the interrupter.

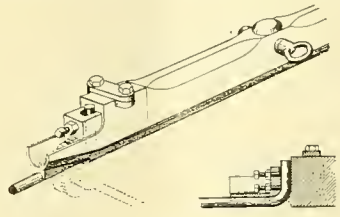
581,023. Section Insulator for Electric Railways. Samuel L. Foster, San Francisco, Cal. Application filed December 23, 1896.

Section insulators and other devices of electric railways are interposed in the path of the trolley, the devices having a terminal member to which the end of the trolley wire is connected, the member having an inclined plane adapted to gradually receive or part with the bearing of the flanges of the trolley wheel before or after the wheel leaves or comes to its bearing on the wire, according as the wheel is entering upon or leaving the terminal.

581,032. Apparatus for Separating Precious Metals from Magnetic Ores. Charles F. Pike, Philadelphia, Pa. Application filed April 6, 1894.

There is a body of mercury upon or over which ore is placed or caused to move with an electro-magnet above the mercury, and an electro-magnet below the mercury, and electric circuits in which the magnets are situated.

581,034. Process of and Apparatus for Separatiog Precious Metals from Magnetic Ores. Charles F. Pike, Philadelphia, Pa. Application filed October 21, 1896.



NO. 581,023.

The process of separatiog gold from magnetic ores consists in placing the ore above a bed of mercury, subjecting the ore to the influence of a magnetic field to draw the ore below the surface of the mercury, and then releasing the ore to permit the particles of ore to separate and rise through the mercury.

581,044. Annunciator Signal for Telephone Systems. William F. Smith, San Francisco, Cal. Application filed August 4, 1894.

A register mechanism for telephone lines, comprising register wheels arranged behind a sight-opening at a switchboard, a rotating barrel carrying loose gears, one to each register wheel, and connected to it by intermediate gearing; means for locking the loose gears separately and in successive order at the beginning of each rotative movement of the barrel, and means for releasing each locked gear at the end of each rotative movement before the next one of the gears is locked; means actuated by pulsations of an electric current to rotate the barrel step by step a predetermined distance to set the register wheels, and means for releasing the barrel at the end of each setting movement, and a spring arranged to restore the barrel to its first position.

581,052. Apparatus for Bleaching by Electrolysis. Albert E. Woolf, New York, N. Y. Application filed December 30, 1896.

The bleaching tank has a perforated false bottom or strainer near its bottom and a shaft provided with agitating arms; there are also an elevated electrolyzing tank having positive electrodes of platinum, or a metal of the platinum group, and suitable negative electrodes, both connecting with a source of electricity; an overflow liquor tank below, and arranged to receive the products from the electrolyzing tank, a pipe leading from the liquor tank to the bleaching tank, a pipe connecting with the bleaching tank below its strainer, a pump connecting therewith, and a discharge pipe entering the electrolyzing tank at or near its bottom.

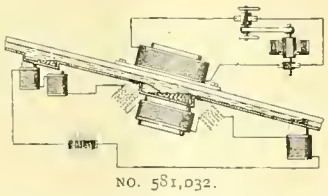
581,089. Dynamo-electric Machine. Martin O. Southworth, Indianapolis, Ind. Application filed September 22, 1896.

One feature of the arrangement is a casting embodying a set of shoes for dynamo-electric machines united by webs and provided with lugs, whereby they may be secured to the face-plate of the turning machine, and thus finished altogether before separation.

581,090. Incandescent Lamp for Liquid Hydro-carbons. Konrad Trobach, Pankow, Germany. Application filed September 16, 1895.

In an incandescent lamp for liquid hydro-carbons there is a detachable holder consisting of a tubular portion provided at its lower end with an enlarged base, having a covering screen at the lower end of the tubular portion of the holder.

581,091. Electro-medical Apparatus. Reinhold H. Wappler, New York, N. Y. Application filed February 5, 1897.



NO. 581,032.

The inventor describes the combination with a resistance cylinder, having a fine-wire surface winding, a dynamo or other source of electric energy, and wires therefrom to the winding of the cylinder to complete the main circuit, of movable terminals or contacts bearing upon the surface winding of the cylinder, supports therefor, and means for moving the same, a shunt circuit whose terminals are connected respectively to the movable contacts, whereby the current diverted into the shunt circuit can be increased and decreased, reversed and varied at the will of the operator.

581,101. Magnet. Goveurneer G. Brown, Brooklyn, N. Y. Application filed April 7, 1896.

In a magnetic ore separator the combination is presented of a chute having a compartment therein, the compartment being adapted to contain the flanges or shelves of magnetic pole-pieces, with the coils of a magnet having pole-pieces adapted to turn therein extending beyond the outer ends thereof, the pole-pieces being provided with flanges or shelves projected laterally from the outer or free ends thereof, and having their inner ends adjustably connected with the armature, and means for adjusting the pole-pieces and flanges within the chute.

581,104. Construction of Batteries. Edward N. Dickerson, New York, N. Y. Application filed March 28, 1892.

In a caseless battery there is the combination with the plates respectively electro-positive and electro-negative to each other, each plate being provided with extensions, the extensions of the positive plates being at a different point from the extensions of the negative plates, of gaskets between the elements and extending around three edges of the plates, the outer frames, screw-rods connecting the frames for drawing the plates against the gaskets, and two of the rods connecting respectively with the extensions of the different plates.

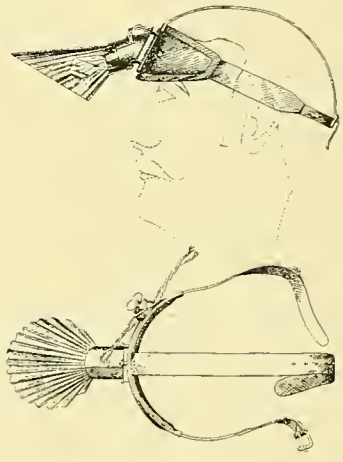
581,129. Electric Light and Head-gear for Surgical Use. Laird W. Nevius, Chicago, Ill. Application filed March 20, 1896.

An adjustable main band is adapted to fit around the head; an adjustable supplementary band is secured to the main band and adapted to be passed across the top of the head, a non-heat-conducting pad is secured to the main band, a base portion is provided for holding the electric lamp, and lugs by which the base portion is secured to the main band portion, so as to provide an air space between such portions, a switch on the main band portion, and a wire connecting the switch and lamp, and adapted to connect the parts with a source of electric energy.

581,135. Telegraph Key. Martin M. Porter, Malone, N. Y. Application filed May 13, 1896.

This instrument comprises a key-lever, a finger-piece having connection therewith, a contact-plate on the finger-piece in electrical connection with the lever, a plate having hinge connection with the finger-piece and covering the entire top surface thereof, a spring-plate connected to the lever and to a post for a line wire, and a pin on the hinged plate for engaging with the spring-plate.

581,136. Electric Arc Lamp. William L. Preece, Derby, England. Application filed July 7, 1896.



NO. 581,129.

A frictional grip for a rod or similar part, comprising a hollow case surrounding the same and having an internal inclined face, a sleeve surrounding the rod or part within the case and provided with apertures, and a series of balls or rollers held in the apertures in the sleeve and bearing upon the rod or part and upon the inclined face of the case.

581,170. Electrical Resistance Coil. John Nebel, London, England. Application filed June 12, 1895. Patented in England November 29, 1892.

A wire helix of low conductivity is embeded in insulating granular material within a metal tube lined with insulating material and closed at the ends by insulating plugs through which the wire passes.

581,204. Electric Pump. Birger Heftye, Tuxpan, Mexico. Application filed October 10, 1896.

One claim is given: In a magneto-electric pump, the combination with the pump cylinders provided with induction and eduction pipes and valves, and wound with motor coils adapted to be connected with an electric generator to form electro-magnets, the opposite poles of which are in reverse directions, and the connected pistons wound with motor coils adapted to be electrically connected with an electric generator to form independent electro-magnets, and means for shifting the poles of the pistons of the rheostat in the circuit between the generator and the cylinder and pistons.

581,242. Erecting Aerial Electric Cables. Francis S. Vielé, Pittsburg, Pa. Application filed November 12, 1896.

The ends of a curved rail are secured by clamps to the messenger wire, and an arm is adapted to be secured to the messenger-wire support.

581,246. Combined Telephone and Electric Lighting System. Charles E. Buell, North Plainfield, N. J. Application filed July 27, 1896.

A series of lines radiating from an electric lighting switchboard, a generator for charging the lines, connections from the lines to a telephone switchboard, devices at subscribers' stations for cutting off the charging current, and connections from the several lines to apparatus for oral communication.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MAY 8, 1897. No. 19

Two Recent Deaths.

It is 36 years since the breaking out of the Rebellion, and the survivors of the men who were connected with the telegraphic industry at or before that historic period have now arrived at an age when the deaths are mournfully frequent. The gaps in the ranks of the old-timers were made especially noticeable by several deaths last month, and last week the names of F. G. Beach and M. C. Bristol were added to the lengthening list. Mr. Beach was best known as the telephone pioneer of the West, but, like so many other telephone men, he was an old telegrapher.

FRANKLIN G. BEACH.

Mr. Beach, who was general manager of the Central Union Telephone company of Chicago, died at his home in Evanston on April 28th. He had been ill for three months with a complication of diseases which terminated in cerebral hemorrhage. His friends had been expecting his death for some time. His wife, Mrs. Elizabeth Beach, survives him. The funeral took place on Saturday morning, May 1st.

A man of great energy and devoted to his business, Mr. Beach was one of the best informed telephone men in the country. He was widely known, too, in other lines of electrical endeavor, and he served one term as president of the old Chicago Electric club—an office to which he was elected in 1889 and which he filled to the entire satisfaction of the members. He was born in Monroe, Mich., in 1840, and his early years were passed in that state. At the age of 16 he became a telegraph operator and occupied positions in Chicago and St. Louis until 1864, when he went to New York to accept a position with the American Telegraph company. Later he became manager of the operating department of the United States Telegraph company at New York, and retained that position until the Western Union company secured control of the United States company. Mr. Beach then established a commercial news agency on Broadway, New York, and this venture proved so successful that it attracted considerable attention. When the Western Union company became his rival, establishing its gold and stock service, then known as a commercial news bureau, Mr. Beach withdrew from the field.

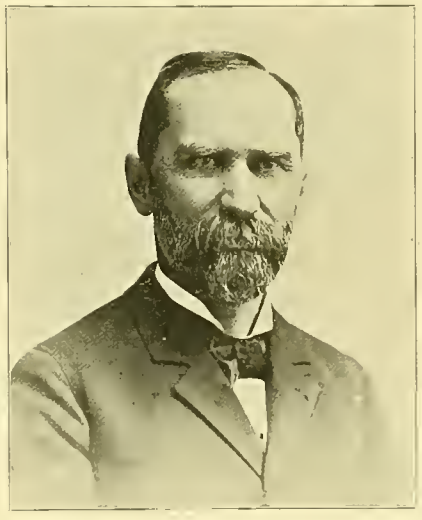
At this time Mr. Beach returned to the West and located temporarily at Detroit, where he occupied the position of manager of the Atlantic & Pacific Telegraph company. Later he was sent to Cleveland in the same capacity, and after a short time was promoted to the position of division superintendent, with headquarters at Chicago. In 1875 Mr. Beach resigned, and for four years had no connection with any electrical company. In July, 1879, however, the Western Union company appointed him special agent of its telephone department, but four months later all the telephone patents passed into the hands of the Bell company. When this change was made the territory now controlled by the Central Union Telephone company was divided between the Midland, Central and Western Telephone companies. These companies were under one management, and Mr. Beach was superintendent. To his efforts, largely, can be attributed their success. When the Central Union Telephone company was formed and the three companies referred to were consolidated, Mr. Beach was made general manager, which position he retained to the end. He was practically at the head of the telephone business in this section from the beginning, and was untiring in his efforts to develop it. From an insignificant concern the Central Union has become an important corporation, with 132 exchanges, 18,000 miles of wire and an outstanding capital stock of $6,600,000.

Socially, Mr. Beach was a great favorite. In Evanston, where he had lived for 10 years, he was a welcome frequenter of the Evanston, Country and Boat clubs, being a member of all of them. He was also a member of the Lotos club of New York.

MERRITT C. BRISTOL.

Merritt C. Bristol, superintendent of construction of the western division of the Western Union Telegraph company, with headquarters in Chicago, died in this city on April 30th. He had been ill for two months, the cause of death being typhoid malarial fever. Mr. Bristol was born in New York state in 1842. In 1861 he entered the service of the Western Union Telegraph company. In the following year he joined the United States Military Telegraph Corps, but later he returned to the service of the Western Union. He had lived in Chicago since 1879, when he was appointed superintendent of construction of the western division. The funeral services were held at the family residence, No. 5112 Jefferson avenue, on Sunday afternoon. The pall-bearers were W. S. Chapman, the secretary and treasurer of the Central Union Telephone company, and the following-named Western Union officials: J. J. Dickey, district superintendent, Omaha; I. N. Miller, district superintendent, Cincinnati; F. H. Tubbs, district superintendent, Chicago; D. F. Davies, assistant superintendent of construction, Minneapolis; G. F. Swartfiger, assistant superintendent of construction, Chicago.

Franklin G. Beach.



Merritt C. Bristol.

TWO RECENT DEATHS.

Breaking Ground for the Canadian Niagara Power Company's Station.

On the afternoon of Friday, April 30th, the Canadian Niagara Power company broke ground in Victoria Park for the development of power in accordance with the franchise granted to the company by the commissioners of Victoria Park on April 7, 1892. In April, 1896, the Canadian Niagara Power company applied for an 18 months' extension of time in which to commence work. This application met with severe protest on the part of real estate dealers in the vicinity of the Falls, various boards of trade and Canadians in general, so that on April 23d, a year after the application was made for extension, the lieutenant-governor in council refused it, and the power company were forced to either begin work or relinquish its exclusive franchise, for which it is paying $25,000 a year rental. Under the provisions of the franchise the company must have 10,000 electrical horse power developed by November 1, 1898, and water connections made by that date for 25,000 horse power.

Despite the fact that ground has been broken for the power development, it remains for time to show whether the work will be pushed ahead as rapidly as the real estate men hope to see it. There is no doubt of the ability of the Canadian Niagara Power company to rush the work, but some legal questions will have to be decided which may serve to give the power company the extension of time it asked for, even if not for a longer period. In the agreement entered into between the commissioners of Victoria Park and the Canadian Niagara Power company it is provided that "the commissioners shall not grant or confer upon any other company or person any right to take or use the waters of the Niagara river within the limits of the park so long as this agreement is in force, nor will the commissioners themselves engage in making use of the water to generate electric or pneumatic power except for the purposes of the park." This agreement was approved by the Ontario government, but notwithstanding its exclusive provisions the Dominion government soon after granted the Canadian Power company the right "to carry the waters of the Welland and Niagara rivers through the park into the Niagara river above Cedar Island or below the falls." On Tuesday, April 27th, the Ontario Council referred the question of the right of the Dominion government to grant this franchise to the Canadian Power company in view of the exclusive lease to the Canadian Niagara Power company. Other questions were also submitted touching the validity of the charter to the Canadian Power company, and all of these questions, it is expected, will be argued at the May sittings of the Court of Appeals. "The questions are very much involved and complicated," says the order of the Council referring the matter to the court, "and affect rights of such value as to require a decision in advance of rather than after the fact." There is little doubt, as the questions are of such vast importance, That a decision will be asked from the court of last resort in England before the development of power on the Canadian side will be pushed with the zeal of real earnestness, for after paying an annual rental of $25,000 a year the Canadian Niagara Power company cannot afford to have the cloud of doubt hover over the exclusive nature of its rights. To secure this decision will take all of two years.

National Electric Light Association.

As the time approaches for holding the twentieth convention of the National Electric Light association, unusual interest and activity is displayed by the members. The inquiries for hotel accommodations are very large, both from active and associate members and the trade in general, one company alone having reserved 25 rooms and another 14. Notwithstanding the heavy requisitions for accommodations, the committee feels that ample provision has been made for all, as the association has practically the resources of both the International Hotel and Cataract House at its disposal. Secretary Porter points out that it is well, however, to engage rooms early to insure choice locations. This can be done by addressing the hotels direct or the secretary at the headquarters of the association, 136 Liberty street, New York city.

in all probability, and in the meantime the Canadian Power company will be restrained from commencing the development of power under the franchise.

The breaking of ground in Victoria Park on Friday, April 30th, was unannounced and few knew of it. None of the officers of the Canadian Niagara Power company attended. The contractor, A. C. Douglass, was in charge. There were no official ceremonies. It will be recalled that the general plans of the development were prepared by Prof. Unwin of London, England, and accepted by the Ontario government several years ago. Briefly stated, they contemplate the erection of two power houses with a capacity of 125,000 horse power each, and each to be fed by a separate canal. Tunnels, 300 and 800 feet long, will carry the water from the turbines to the lower river.

At present there is but a small local demand for power on the Canadian side of the river, and the prospective markets for the power to be developed are Hamilton and Toronto, the first named city being 40 miles and the latter 90 miles from the proposed power house. The franchise, however, allows the transmission of one-half of the developed power to the United States, and thus the Canadian plant can be made an important adjunct to the Niagara Falls Power company's plant, especially as the Niagara Falls Power company controls a majority of the stock of the Canadian Niagara Power company. The officers of the Canadian Niagara Power company are: President, Col. Albert D. Shaw of Watertown, the former United States consul to Manchester, Eng.; vice-president, Francis Lynde Stetson of New York; secretary-treasurer, William B. Rankine of New York. These gentlemen, with Charles J Holman of Toronto, Ont., form the board of directors.

Sealed proposals are being invited until June 8th for furnishing a quantity of electrical supplies for the Twelfth Lighthouse District. Further information may be obtained upon application to Major C. E. L. B. Davis, San Francisco, Cal.

Arc Lighting in America and Europe.[1]

By C. Wiler.

Scarcely more than 17 years have elapsed since arc lighting became a commercial art. In this short span of time artificial illumination by the voltaic arc has not only excelled all other competitive systems, but has even become an important factor in the rapid development of our modern civilization. A branch of industry which is common property is subject to the individual character of the nation and to influences and changes due to the different social, commercial and geographical causes. America, which in the latter half of this century has taken such a prominent place in the technical world, was much quicker to see the great future of arc lighting than was slow, precautious Europe. The conditions of this country were more favorable for the adoption of the new method of illuminating than they were in the old world. Here an immense area of land and an immense population are under the rule of one general government. American cities are very lenient in allowing the use of their streets and do not impose the financial and technical restrictions that are ordinarily imposed abroad. Europe, on the other hand, is split up into many large and small states, with different customs, racial peculiarities and animosities. The municipal administrations are very careful in the granting of franchises. They keep a watchful eye on the appearance of the streets and wait until a system has been thoroughly tried before they introduce it; but by their strict rules they often check the development of an industry which at the beginning needs a helping hand. In America arc lighting was considered a necessity, while it was a luxury in Europe. It is no wonder, then, that the streets of American cities and towns have been glittering in the splendor of the electric light while Europeans were still content with gas and oil, and thus, too, it became possible that keen foresight and genius developed in our country a system which allowed of an economical distribution over a large area and left nothing to be desired as regards simplicity.

Series arc lighting with constant current dynamos of varying electromotive force found its birthplace, its application and its perfection in America. Up to date it could hardly gain a foothold on the European continent. It was adopted in England at the time that the Brush and Thomson-Houston machines made their first appearance, and although the plants are still running and a few have been added, the system has been nearly entirely abandoned. The desire to supply arc and incandescent light as well as the motive power from one and the same generator, the once low efficiency of arc dynamos, the use of small high-speed units, the consequently inferior arrangement of the steam plant, and last but not least, the high pressure for inferior lighting are the objections made abroad against high-tension series arc lighting. Some of these objections have of late years been overcome in our land since larger units were built. The speed of arc dynamos has been decreased, and, hand in hand therewith, their efficiency has been increased, so that to-day the commercial efficiency of a 60 light dynamo reaches 82 per cent. to 83 per cent.; of a 100 light about 86 per cent. Since, however, the speed has been decreased to about 800 revolutions per minute for 60 light dynamos and to about 500 to 600 revolutions per minute for 100 light dynamos, it has been made possible to escape that labyrinth of countershafts, belts, pulleys, clutches and bearings which for many years was characteristic of an arc plant. This has made possible an economical arrangement of the steam plant. The countershaft can be avoided; arc dynamos have been direct-connected with the steam engine.

Series arc lighting predominates in America. Arc lighting by constant potential circuits was developed much later than in Europe. It has come into extensive use here since 1891, especially in large cities for private lighting. Most of the large direct current supply stations for light and motive power here and abroad use the three-wire system with 220 volts across the outers, in Germany in conjunction with storage batteries. Plants which serve mainly for arc lighting on the European continent use the two-wire system with a pressure from 110 to 650 volts. The turning on or off of public street lamps, which are connected with constantly supplied circuits, is mostly done by hand when the area covered is small. When the supply extends over a large area, street lamps are turned on or off from the station or the distribution point. Each circuit with from two to 12 lamps in series is controlled from the station switchboard or from the distribution center, where the necessary measuring instruments for each circuit (ammeter, voltmeter, polarity indicator) and rheostats are placed.

Fig. 1 is a modification of a diagram from the *Elektrotechnische Zeitschrift*. It shows the arrangement made in the combined arc and railway plants of the city

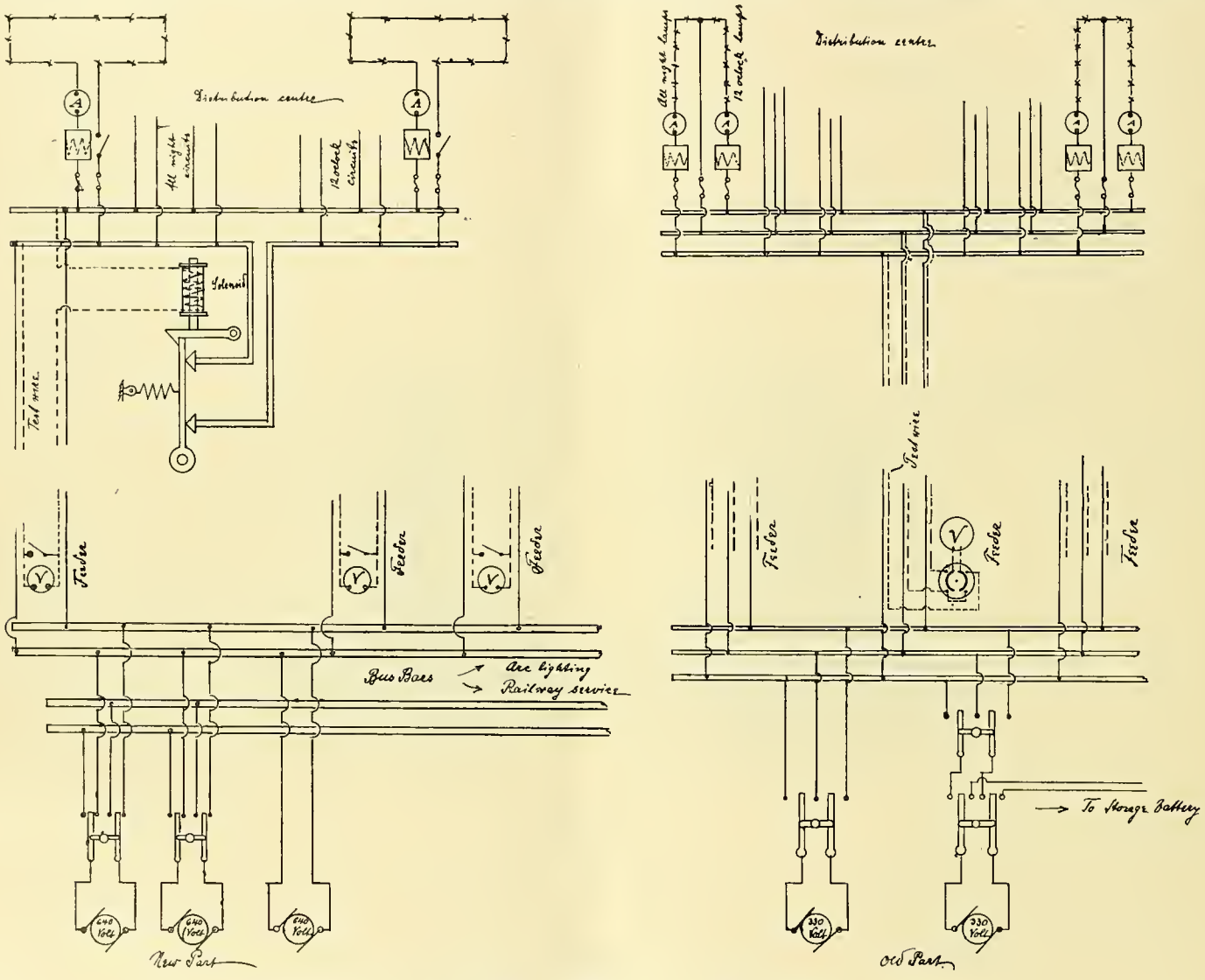


FIG. 1. ARC LIGHTING IN AMERICA AND EUROPE.—COMBINED ARC AND RAILWAY STATION PLANT AT MUNICH, GERMANY.

1. Read before the Chicago Electrical association, April 16, 1897.

of Munich. The voltage of the generators is 640; 12 lamps are connected in series in one circuit. The feeders are run to well designed distribution centers which are located on the street and resemble patrol boxes in their exterior appearance. From these points the arc circuits branch out. The all-night circuits are connected with the same side of the bus-bars in the distribution center as the incoming feeder, while the 12 o'clock circuits are connected with the other side. Both sides can be disconnected by an automatic cut-out, the fine wire winding of which is connected with a test wire which indicates in the station the voltage of the feeder end. By short-circuiting the voltmeter in the station the current rises sufficiently to operate the automatic cut-out, which disconnects the desired circuits. In the old part of the plant the three-wire system is used for the feeders as well as for the arc circuits. The all-night lamps are placed on one side of the neutral, the midnight lights on the other. The three-wire system is changed into a two-wire system after midnight; the disconnected dynamo can be used for the charging of a storage battery during the rest of the night.

Thus far only direct current distribution systems have been considered. Alternating arc lighting has been kept in the background both here and abroad. Only within a few years has it come into a more extensive use, especially in the European continental countries, where it is no longer regarded as much inferior to direct current lighting. The success is to some extent due to moderate frequencies, to the use of the very best, proper size and even special carbons, and to the prevailing tendency of using lamps with a very fine adjustment and slow feed.

Alternating street lamps are connected in America with an individual transformer, the secondary voltage of which is 30 to 40, the primary mostly 1,000 or 2,000. This does not require a great amount of wire, allows an economical distribution over a large area, makes the lamps independent of each other and avoids a complicated lamp mechanism. It has the drawback of requiring a special transformer for each lamp. When alternating arc lamps are connected with incandescent circuits the lamp voltage is obtained either by the introduction of sufficient resistance, by a transformer or by a choking coil, usually called an economy coil. The coils are wound either for 50 volt circuits for the connection of one or two lamps or for 100 to 110 volt circuits for the connection of one to three lamps. Some are arranged so that the lamps can be turned on or off independently of each other.

Since the Frankfort exposition in 1891 a large number of alternating current stations have been built on the European continent. Some of the older ones, as Cologne and Amsterdam, supply each consumer with an individual transformer; the secondary voltage is 72. An intermediate terminal on the transformer allows of the use of single lamps at 36 volts. Most of the stations built later connect the lamps with a network of secondary mains fed from a transformer sub station. The voltage is 110 or 120, so that three lamps can be connected in series with a suitable choking coil, which takes the place of the ohmic resistance of the direct current lamp. Quite recently the Avenue de l'Opera in Paris has been again lighted with alternating current lamps. The first attempt was made in 1878 with Jablochkoff candles, but after 1882 the street was lighted with gas. The primary current is stepped down to 220 volts. Two transformers are used, each supplying five circuits. Five lamps are connected in series on one circuit, requiring (5x36) 180 volts, the choking coil for five lamps requires 20 volts; a drop of 20 volts in the line is allowed, which makes a total of 220. After midnight the illumination is reduced by disconnecting the transformer from the 12 o'clock circuits.

These examples serve to show that alternating arc lighting is in vogue on the European continent. Various attempts have been made to run a large number of alternating arc lamps in series from a constant current dynamo with varying voltage, or they have been connected with a constant current transformer; other methods for alternating series arc lighting have been proposed and tried, none, however, have come into extensive use. The difficulties in high series alternating lighting arise in the lamps, which are not yet satisfactory. They have been overcome in England by rectifying the negative waves of the alternating current. The current from the constant potential alternator is led to a constant current transformer. This consists of movable primary coils and fixed secondaries; the force of repulsion between primary and secondary is balanced by adjustable weights. The regulation is dependent upon the leakage in the transformer. The current is brought from the converter to the rectifier proper, which is a revolving commutator driven by a synchronous motor. The pulsating direct current is sent from here into the line. The crater is formed at the positive carbon; the light is consequently thrown downward, just as in a direct current lamp. A rectifier set requires but small floor space and very little attendance. The wear of the brushes on the commutator is said to be not worse than on arc machines. The efficiency of a 40 light set is about 81 per cent. The rectifier system fills a long-felt want in England, as is amply demonstrated by its rapid introduction. Fig. 2 shows the latest type of Ferranti apparatus; it has a capacity of 50 twelve-ampere lamps. These are the systems which at present are used in America and Europe for the distribution of electrical energy for arc lighting.

In taking up the final conversion into light we will compare European with American lamps. Gravity feed is nowadays used everywhere; the mechanical means for accomplishing the feed, however, differ greatly from each other. The clutch and rod is the American standard; the clutch or brake wheel, in connection with a gear and a rack rod, the English; the rack, the chain or ribbon in connection with a train of wheels, the standard on the continent of Europe. The arc in American lamps is mostly traveling. The interior of the globe, the lower carbon holder and the lamp rod are not protected against the weather. With these concessions a greater simplicity has been obtained than in foreign lamps, which are mostly of the focusing type and encased. English lamps are very simple in construction; those of the other European countries, however, show strongly the hand of the clockmaker. They are often fitted with contrivances which are easily put out of order and are very delicate. For simplicity, ability to stand wear and tear, quick carboning and cleaning, ease of inspection and repair, quick handling and connecting, the American clutch lamp has not been surpassed.

In England the electrical regulation of the lamp is mostly mechanically differential, while in Germany as well as in many other countries the shunt lamp—filled with a shunt magnet, which strikes, regulates and feeds the arc—has displaced the differential type to a great extent. Of late high-tension series arc lamps have come into use in our country which are focusing, encased, of the clutch type, short length, ornamental in their outer appearance and fitted with a single pair of carbons for all-night lighting. Double-carbon lamps are very seldom used at present in new installations; single-carbon lamps with five-eighths inch carbons and the necessary length for all-night lighting take their place. Double-carbon focusing lamps are used in England; five-eighths inch or eleven-sixteenths inch carbons are used for all-night lighting elsewhere in Europe.

Very little need be said about the European solid and cored carbons. They are used extensively here and are well known. The purpose of the core is to anchor the arc and keep it from wandering about, which results when the section of the carbon is too large in proportion to the current. The core decreases the resistance of the arc by the higher conductivity of the vaporated material and allows a lower lamp voltage. Coated carbons are unknown abroad, and at present are used here less than heretofore. Their use was justified in the earlier days when the resistance of the carbons was high and their life short. The thin coat of copper which surrounds the lower part of the peak of the negative carbon, where the temperature is not high enough to melt it very readily, intercepts a good deal of the light. The molten globules of copper which drop on the glass globe and adhere to it account to some degree for the breakage of the thus disfigured globes. It is just as important to use good carbons and of the proper size as it is to employ efficient machinery. Else the advantages gained by one are offset by the disadvantages of the other.

To the progress in the manufacture of carbons is due the perfection of the long-burning arc lamps with enclosed arc. The arc in these lamps is surrounded with a small glass globe which is closed air-tight at the bottom. At the top it is closed in such a manner as to allow the passing through of the positive carbon, the escapement of the products of combustion and the entering of fresh air. The oxygen of the air combines with the free carbon to CO_2 and CO and prevents its deposit and blackening of the globe. The lamp which has become standard in the United States—abroad it is hardly in use at present—consumes 4.5 to 5 amperes at a pressure of 110 volts. The arc voltage is about 80. The balance is taken up in a resistance which serves for the steadying of the arc. Aside from the great saving in carbons and attendance, these lamps have the advantage that they can be connected singly with a 110 volt circuit, whereas thus far constant potential arc lamps had to be run in pairs on 110 volt circuits. Long-life arc lamps require when run singly only a simple mechanism with a main circuit magnet; they are perfect spark arresters. The double globes, with which the lamps are fitted, diffuse the light very evenly when properly selected.

Clear glass globes for street lighting are used in America, while abroad diffusing (opalescent, opaline,

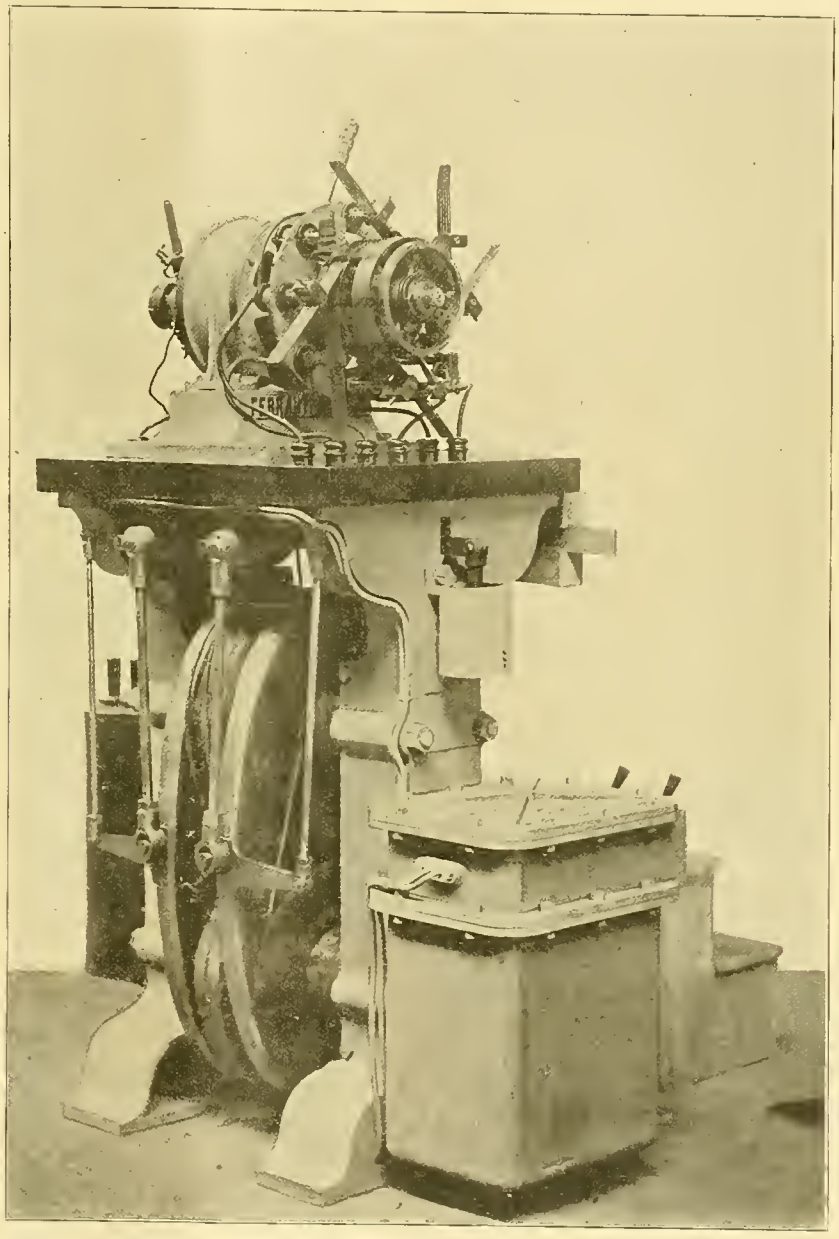


FIG. 2. ARC LIGHTING IN AMERICA AND EUROPE.—FERRANTI ALTERNATING CURRENT RECTIFIER.

alabastrine) globes are used. European critics, who usually describe these clear globes as a mere protection against the weather, have often made them the target of their sarcastic remarks and have blamed the American public for the poor protection they afford the eye. Of late, however, opalescent globes have come into use. Different attempts have been made to reduce the loss in light produced by the use of the diffusing globes in outside service and to gain a better distribution. Although these attempts are old it is only since a short time that they have reappeared again, greatly improved and modified in France in the holophane or entirely luminous globes. The outer surface of these clear transparent globes is covered with a large number of very small horizontal ribs and groovings (prisms). They have two faces, one reflecting and the other refracting, and spread the light vertically. The shape of these prisms is different according to their relative position to the light. The inner surface of the globes is covered with a large number of vertical flutes, which spread the light horizontally. The flutes are concave at the bottom and separated by narrow ribs. The loss in light is very small compared with other diffusing globes, and the light is better distributed. Holophane globes are expensive at present, are difficult to clean, are split in two halves, and require special fittings for their support. Two-part globes are sometimes used in France, where for street lighting the harp and hood are in very extensive use for the rigid support of lamps on posts. Quite sharply marked from this is the German method, which supports street lamps on a so-called bishop's crook (Fig. 3)—a straight ornamental stem with a crook at the end—in such a manner that they can be lowered for the trimming. This avoids the use of a ladder or of steps on the post, but the line wires hang flopping about, which does not add to the beauty of the post or to the insulation resistance of the net. Where high voltages are used, lamps are rigidly supported on the post and carefully insulated from the ground. The American hood with its wooden hangerboard and post answers these requirements. Since the voltage on arc circuits has in late years been nearly doubled, the hangerboard and hood have been discarded, with the outside exposed binding posts of the lamp located in the inside; the weatherproof lamp is insulated suspended on the post.

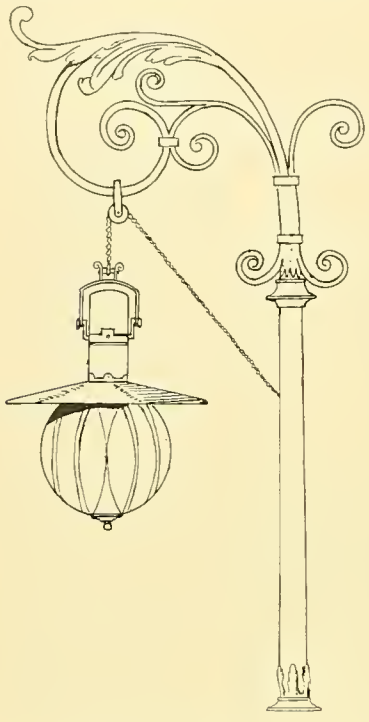


FIG. 3. ARC LIGHTING IN AMERICA AND EUROPE.—GERMAN DESIGN.

An excellent idea of the style of lamp-post in general use in France is given in Fig. 4. This type has also been introduced of late in England, but heretofore the design shown in Fig. 5 was pretty generally used. In Portsmouth the character of the service requires the employment of a lamp-post designed on the plan of Fig. 6. This is a combination post, providing for both arc and incandescent lamps. The arc lamps are burned on the streets until midnight in Portsmouth, at which time they are cut out and the incandescent lamps turned on. Recently arrangements were made for switching the lights on and off from the station. Before this was done an employe rode from post to post on his bicycle every night.

Arc lighting is by far not in as general use as it is here. Public street lighting is very often confined to the main thoroughfares. The conditions under which arc lighting developed in America and Europe differ greatly, as shown, and the results are a consequence of these varying conditions. On both hemispheres the effort has been made to advance the development of arc lighting, further its progress and make it an important link in the chain which drives the world's restless machinery.

Important Changes in the Patent Law.

In the excitement attendant on the change of administrations at Washington, the fact that there were important changes made in the patent laws on March 3, 1897, seems to have escaped general notice.

One of the two new statutes passed is almost entirely amendatory. It amends sections 4886 and 4920 of the Revised Statutes of the United States, adding to the conditions of obtaining a patent that the invention shall not have been published more than two years prior to the application, in any printed publication in this or any foreign country, and making it a defense to an action for infringement that the invention has been described in some printed publication more than two years prior to the application for a patent therefor.

Such changes are made in section 4887, of the old law, that the fact that a patent has been obtained in a foreign country by the inventor or his legal representatives or assigns, before it is obtained here, shall not limit the term of the patent in the United States, though the application for a patent must be filed in this country within seven months after the filing of the application for the foreign patent, or no patent will be granted in this country. As the law was before, patents that would otherwise have run 17 years in this country have been limited to two years, five years, and all sorts of terms, by reason of the fact that they were first taken out in foreign countries.

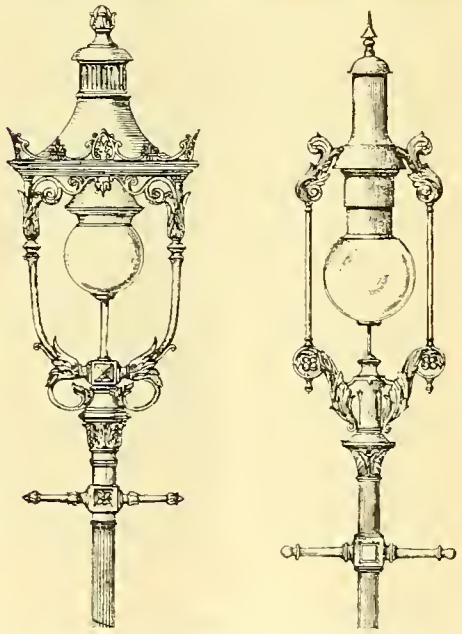
The right of a party to proceed in his application for a patent, once having been rejected, was limited by section 4894 to two years; but the commissioner of patents managed to change the rule, making it six months, which the patent lawyers greatly disliked. Now the time is fixed at one year, a compromise which is believed to be satisfactory to all.

Section 4898, relating to the assignment of patents, is amended by the addition of the provision that if any assignment, grant or conveyance of any patent shall be acknowledged before any notary public of the several states or territories or the District of Columbia, or any commissioner of the United States Circuit Court, or before any secretary of legation or consular officer authorized to administer oaths or perform notarial acts under section 1750, the certificate of acknowledgment shall be presumptive evidence of the execution of such instrument.

Section 4921, concerning the estimation of damages for infringement, has added to it the provision that in any suit for infringement there shall be no recovery of profits or damages for any infringement committed more than six years before the filing of the bill of complaint therein, which provision shall apply to existing causes of action. In every case where the head of any department of the government shall request the commissioner of patents to expedite the consideration of an application for a patent, it shall be the duty of such head of a department to be represented before the commissioner to prevent the improper issue of a patent. This is an entirely new provision.

January 1, 1898, is the date set for the taking effect of all the foregoing changes, though the amendments to sections 4886, 4920, 4887 and 4894, it is declared, shall not apply to any patent granted prior to that date, to any application filed prior thereto, nor to any patent granted on it.

The other statute passed is intended to cure the evil growing out of the fact that corporations using patented inventions frequently go for their charters into other states than those where they do their business, making it very difficult to serve papers on them in the states of their incorporation, where the law has heretofore required suit to be brought. The new law authorizes suit to be brought in the place where the business is carried on, and service to be made upon an agent, in the case of a corporation. The amendments took effect March 3, 1897.



FIGS. 4 AND 5. ARC LIGHTING IN AMERICA AND EUROPE.—FRENCH AND ENGLISH DESIGNS.

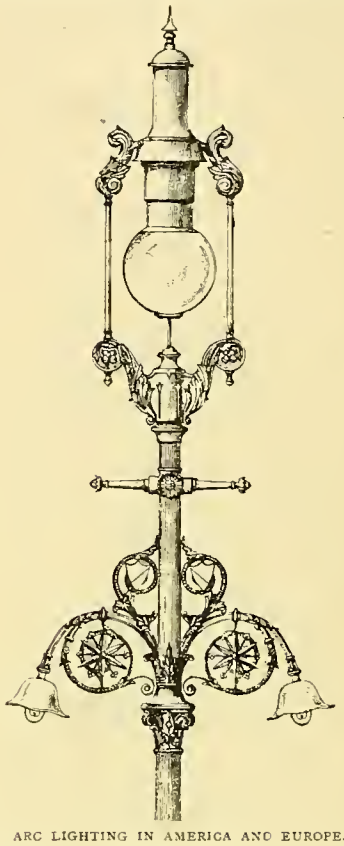


FIG. 6. ARC LIGHTING IN AMERICA AND EUROPE.—COMBINATION POST.

Slacking Speed Between Stopping Places.

It is the legal duty of a street railway company to stop its cars at suitable places for passengers to leave them, and have the cars remain stationary long enough to enable them to do so safely. But a case just recorded in the Pennsylvania reports presents an instance where a business man using a certain line of cars to shorten his walk was in the habit of leaping from the cars at a point where they did not ordinarily stop, from which point he walked to his home. He alleged that the conductor and motorman knew of this habit, and, at a signal from him, would slacken the speed of the car down to about four or five miles per hour, in order to relieve him from the dangers incident to this mode of alighting as much as they reasonably could. Granting that this was so, the Supreme Court of Pennsylvania holds that the company was not bound by this practice nor by the good nature of its employes, as thus manifested. To leap at all from a moving car it pronounces such contributory negligence as will defeat an action for damages for injuries sustained, unless the motion be so inconsiderable that a person of reasonable prudence, exercising ordinary care, would not hesitate about the safety of the attempt to alight. That the attempt to leap from an electric car moving at the rate of from four to five miles per hour is contributory negligence in the passenger, it further holds, could be properly declared by the court, on a motion for a compulsory nonsuit, without referring the question to the jury.

Charles E. Rector, acting under the engineering advice of B. J. Arnold, has closed contracts for a 50 kilowatt direct-connected electric lighting plant to replace the old outfit used in connection with his Chicago restaurant. New wiring and one new boiler are included in the remodeled plant.

Dr. G. H. B. Zahn.

In estimating the value of the World's Fair some consideration should be given to the fact that many foreigners who were attracted to this country by the exhibition at Chicago in 1893 were so deeply impressed by the advantages to be had here that they determined to make America their home. In this way the United States has gained many desirable candidates for citizenship among scientists who were trained in the universities of the Old World, and who otherwise might have passed their lives in their native land. The electrical fraternity has received many valuable acquisitions in this manner, as all who had occasion to meet the foreign visitors at the Columbian Exposition know.

Among those whose subsequent labors have attracted attention in the electrical field, the subject of this sketch has gained creditable distinction. Dr. G. H. B. Zahn of Dayton, Ohio, was born in Germany 28 years ago. In his boyhood he had the usual training in the public schools and was graduated by the gymnasium at Wiesbaden in 1889. He then went to the University of Strasburg, where he devoted himself to the study of mathematics, chemistry and physics, paying especial attention to electrical science under the guidance of Professor Kohlrausch, who is now president of the Imperial Phys. Techn. Institute at Berlin. In 2½ years at Strasburg Mr. Zahn not only passed through the regular course of study, but he also finished a thesis on an electro-chemical subject. He then devoted some time to the study of electro-metallurgy and in May, 1892, he received the degree of Ph. D., after examination in physics, chemistry and mathematics. He then spent considerable time at the Polytechnicum at Zurich, Switzerland, where he devoted himself to the regular course of electrical engineering, dynamo design, etc., as well as to scientific researches on alternating currents and the application of condensers to alternating current work. In the spring of 1893 Dr. Zahn came to the United States to visit the World's Fair and study the methods of American manufacture, especially in regard to electrical engineering. Having spent some time at Chicago, he designed for several electrical companies alternating current dynamos and transformers, as well as incandescent and arc dynamos, and was also engaged as consulting engineer in several important projects. After a short trip to Europe in 1895, Dr. Zahn went to Ohio, where he designed a line of gas engines for an Ohio company and devoted himself principally to consulting work. For the purposes of later publication he made a great number of comparative tests on gas, gasoline and oil engines, the results of which will be published in the near future, together with tests of the prominent European machines of that class.

DR. G. H. B. ZAHN.

Dr. Zahn is at present at Berlin, Germany. On his return he will continue his work as a consulting engineer, for which profession his liberal education and wide experience abroad, together with his familiarity with American practice, fit him. During his residence in this country he has made some valuable contributions to electrical literature. Several of these have been published in the WESTERN ELECTRICIAN, including a recent article on "Transmission of Heavy Currents." "A Central Station with Three-phased Current Generators," "Cup Armature Dynamo" and "Selecting an Electric Motor," were subjects of earlier contributions. In these articles Dr. Zahn has displayed the same thorough knowledge of the subject that has marked all his work. He has also established a reputation as a designer of electrical machinery, during his residence in this country. Probably his best known work in this particular line is the multipolar dynamo and motor, which has been described and illustrated in this journal.

Dr. Zahn's latest and most extensive work is a series of six lectures upon "Direct Current Dynamo Design," which he has just completed for the WESTERN ELECTRICIAN and which will be presented in serial form in this journal. These lectures will be copiously illustrated by original drawings and they will be supplemented by valuable data presented in tabular form. In these lectures the author has aimed to present in a concise and graphic manner the best ideas of foreign engineers and the most approved American practice. Consequently they will be of especial value to engineers seeking brief but thorough information. They will contain all the necessary electrical, magnetic and mechanical data for the construction of such machines. Realizing that a great help in designing a new dynamo will be a careful study of the dimensions of the parts of standard machines, especially in regard to their fitness for special service, several examples have been presented for the consideration of readers. It is confidently anticipated that these articles will prove of great value to students, designers and engineers, and they will no doubt be fully appreciated.

Mechanics' Institute of San Francisco.

The thirtieth industrial exposition of the Mechanics' Institute of San Francisco has been announced to open August 17 and close September 18, 1897. The fair is said to afford an excellent opportunity for eastern manufacturers and producers to place their products before the consumers of the Pacific Coast. Heretofore, these expositions have been mostly confined to exhibits showing the progress of California in art, science, mechanics, agriculture and horticulture, but it is proposed to enlarge the scope of the exposition this year and receive exhibits from all over the country.

The fair will be held in the Mechanics' Pavilion, a building of two stories, covering a whole block adjoining the city hall, and in the heart of the city. It has an ample floor area of three and one-half acres, and is easily accessible by all car lines. Exhibitors will be aided by generous concessions and a liberal management to present their exhibits in the most attractive form; and a large attendance will be ensured by low rates of admission, exceptional attractions, special days and excursions from the interior towns. Power for machinery will be supplied free of expense. Space, water and lighting will also be free to exhibitors. Liberal premiums will be given.

The Mechanics' Institute has a membership of nearly 5,000. The proceeds of these fairs are expended in paying premiums and in the building up and maintenance of a large and growing library, free lectures and classes, and the dissemination of knowledge. Premium lists and other information will be supplied on application to E. P. Heald, secretary, No. 31 Post street, San Francisco, Cal.

Mr. Arnold's Lectures Appreciated.

The merits of Mr. Arnold's lectures on "Design and Construction of Electric Power Plants," now being published in the WESTERN ELECTRICIAN, are receiving deserved recognition, especially in such educational institutions as have an electrical engineering department. From one prominent university last week 11 subscriptions were received, all of the subscribers being students in electrical engineering.

Electricity and Compressed Air Not Rivals, but Useful Agents for Varying Purposes.

[From the *American Engineer*.]

At the June convention of the Master Mechanics' association, a report is expected on the subject of motors for shops—steam, air and electric. The practical abandonment of steam motors for all purposes outside of the main power plant is so general that we may expect the report to be largely devoted to compressed air and electricity. It is an interesting subject, and if the committee will realize that there is a field for each of these types of motors and will as far as possible define those fields, a valuable work will have been accomplished. To an impartial mind, both compressed air and electricity appear as valuable agents for the transmission of power. Both have the advantages of small loss in transmission and of conductors at the temperature of the surrounding atmosphere and suitable for almost all places and positions. In the storage of power compressed air appears to have an advantage over its competitor. When, however, we come to utilize the power transmitted we are at once confronted with the fact that electricity can be used satisfactorily only where a rotary motion is suitable to the work in hand, while the forte of compressed air is not rotary but reciprocation motion. The relative values of the two agents consequently depend not altogether upon the methods or economy of generating and transmitting the power by each, but somewhat upon the facility with which each can be employed at the various points, and to the work for which the power was generated. Under these circumstances it would appear almost axiomatic and entirely beyond dispute that each of these agents has its legitimate field. At present there seems to be a disposition on the part of the advocates of each to urge the use of one to the exclusion of the other, but we venture the prediction that in the near future large shops will be equipped with both electricity and compressed air for power purposes. Why not? This present hustling after compressed-air tools, much as it is to be commended, does not arise from the fact that it is superior to all known agents for all purposes, but because it is much cheaper than the manual labor it replaces; in fact, the cases are legion where compressed air is generated and used in a thoroughly wasteful fashion, and yet saves much money when compared with former methods involving more manual labor. When we get far enough into the new order of things to be more concerned in how much more we can save than in the good work already done, the wasteful methods of using air will not be tolerated, and where the use of electricity is the proper solution for individual cases, that agent will surely be employed. Then we will find electric generators and air compressors both installed in the one plant, and each time it is decided to employ power for certain operations formerly done by hand, the agent more suitable for that particular case will be selected. Such acourse will not result in reducing the extent to which compressed air is used, for the employment of both air and electricity is bound to extend greatly as the result of the ever pressing demand for economy in shop operations.

Canadian and United States Tariff Bills of 1897 and British Tariff.

As soon as the Canadian tariff and the United States tariff bills now pending become law, a special edition of the *Canadian Manufacturer* of Toronto, Ont., will be published containing both of them and also the British tariff bill now in force, all reproduced in full from authentic copies obtained from official sources. As soon as the new Canadian tariff bill is presented in the House of Commons at Ottawa it becomes the law of the land, going into effect immediately. The Dominion Parliament being already in session, it is the announced intention of the government to present the tariff bill with as little delay as possible. The new United States tariff bill now before Congress is expected to become a law and go into effect at an early day.

National Association of Street Railway Employes.

"My report as secretary of the National Association of Street Railway Employes will show a marked degree of improvement for the past year," said Rezin Orr to a reporter when discussing the annual convention of the organization in Dayton, O. He says that there certainly has been a marked degree of progress since the last convention, especially so when the all-pervading business depression is taken into account. Thirty-two divisions have been organized during the year, a greater number than for any similar period since the formation of the national association at Indianapolis in 1892.

At the last convention a death benefit was established, and all just death claims have been promptly adjusted, and a handsome balance is yet to the credit of that fund.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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It is said that the Illinois Central railroad authorities have decided to take no definite action for a year in the matter of the electrical equipment for the suburban service at Chicago. In the meantime various plans and methods of electric traction will be carefully considered by Chief Engineer Wallace, with the active advice and assistance of John Lundie, the mechanical engineer.

VERY little positive information of the exact condition of affairs could be gained by one unfamiliar with the business of the General Electric company by the most careful perusal of the annual report just submitted by President Coffin. It is admitted that there has been a very marked shrinkage, especially during the latter half of the year, but it is added that "with a return to normal commercial conditions, a corresponding revival in the business of your company may be expected." In support of this position, it is shown that "the volume of business secured by the company for the first three months of the current year is slightly in excess of that for the same period in either of the three previous years." An improvement, such as that indicated, would indeed be welcomed on every side.

An examination of the report of the financial branch of the business shows that the "very marked shrinkage" which has been noted in other departments is not recognized there. The value of patents controlled by the company still remains at $8,000,000, according to Vice-president Ord's estimate, and the securities which are owned by the company are rated at full value. The company is indeed fortunate in being so exceptionally favored at this time.

IN striking contrast to the excellent record made by Chicago during the World's Fair in handling the immense throngs that visited the city at that time was the poor showing of New York in its feeble attempt to provide transportation accommodations during the dedicatory exercises of the Grant monument. The *Herald* comments editorially on the lack of facilities, and says: "The need of rapid transit in this city and a bridge across the Hudson River was never so greatly emphasized as on Tuesday. It is to be hoped that the persons who have these enterprises in charge will be stirred into greater activity by the object lesson they received." Poor old New York!

ELECTRICITY is property—in a legal sense, at least—down in Kentucky. In the Criminal Court at Louisville, last week, Judge Noble overruled a motion to dismiss the case of a saloon-keeper who had tapped an electric light wire, and who maintained that he had taken nothing of value. It was in passing upon this point that Judge Noble decided that "electricity is property," and ordered that the case be tried on its merits. It is not to be expected, however, that this decision will be accepted as a scientific definition by those who have been engaged in an attempt to solve the problem of the identity of electricity. But it may be accepted as a fact that Judge Noble will hereafter be regarded as an authority by central station owners.

MEMBERS of the American Institute of Electrical Engineers look forward to the annual meeting, which is to be held in New York on May 18th, with much interest. The organization has added many new members during the last year and it has gained some valuable acquisitions. But there is still much work to be done, and with the infusion of new life into the management it is believed still greater advances may be made. The regular ticket which has been prepared for this occasion contains many excellent names and as a whole is acceptable.

Reports of the work done by the western members indicate that interest in the proceedings of the meetings held in Chicago is also increasing. Those in charge of this work have certainly been untiring in their efforts.

AMONG the privileges accorded to tenants by the modern decisions which elevate them above the position of mere vassals to their landlords may be classed the right to remove, during the term of their leases, all trade fixtures annexed to the leased premises, and, in the absence of any stipulation to the contrary, to also remove, during the same period, erections and additions made by them upon the premises which would at one time have been considered permanent fixtures. In view of this modern doctrine, the Supreme Court of Oregon says, in a recent decision, that it cannot think that dynamos and other electric light machinery put in by a tenant for an electric light system extending to other buildings are to be classed as erections or additions made upon the leased premises, even where the lease expressly provides that at the end of the term the lessee shall deliver up the premises "and all future erections and additions to or upon the same."

WHAT is legally a "line" for telephone taxation? A provision of Florida law is that telephone companies shall each pay, on every plant, a license tax of $100; provided, telephone lines of less than 25 miles in length shall pay a license tax of $25. The question was raised, in the case of Southern Bell Telephone & Telegraph company against D'Alemberte, as to what constituted a line. The company contended that its line was to be estimated at the sum of the distances covered by the poles supporting its wires, because in the telephone business the word "line" means "a line of poles and the wires suspended thereon, without regard to the number of those wires." But, while it is true, as a general rule, that popular words are to be construed in the popular sense, and technical words in a technical sense, when used in a statute, yet, the Supreme Court of Florida maintains, in its decision of this case, that when a word has both a popular and a technical meaning, the court will give it effect according to the popular signification, if it was so used by the Legislature, and the context may be referred to in ascertaining the sense in which it was used. In harmony with this, the Supreme Court holds that, under the statute mentioned, where a telephone plant consists of separate wires and instruments for the use of subscribers, all connecting with each other by means of a call wire common to all at a central office, and the sum of the length of all its wires thus in use exceeds 25 miles, the company operating such plant is subject to a license tax of $100, although the sum of the distances covered by the poles supporting its wires is less than 25 miles.

RUMORS of several important deals involving the purchase of independent telephone exchanges by the Bell interests have been circulated of late, especially in the East, where the old concern is making a desperate fight to maintain its position. The object of all these stories about the failure of new companies to establish a paying business and the readiness of the owners to turn over the property to the Bell companies is apparent to all familiar with the situation. It may be remarked that the Bell company is not buying up worthless exchanges, nor is it investing its money in non-productive property, such as the independent companies' plants have been described to be by the old concern. As a matter of fact the announcement that the Bell company has purchased an independent company's equipment may be accepted as an admission of defeat on the part of the purchaser. That is the last resort of the Bell company. All other methods must have failed to drive out competition before the Bell company consented to part with any portion of its spoils.

In the West the independent companies are making such progress that the Bell company has found it necessary to circulate statements showing the increase in the number of instruments it has in use in its system, and in doing so it has created an erroneous impression. For instance, where a new subscriber is added to the service the record is made to show two instruments, but no explanation is made that this pair of instruments—receiver and transmitter—constitutes one set and means only one additional subscriber.

THE paper by Prof. Crehore and Lieut. Squier upon the synchronograph before the American Institute of Electrical Engineers has attracted considerable attention to the history of the art of telegraphy, and many of the remarkable feats heretofore accomplished are described. An operator who contributes some interesting reminiscences in the *Sun* says that men who are familiar with some of the remarkable word-sending feats accomplished within the last 25 years are not surprised at the possibilities of the system described, although its practicability in commercial work has yet to be demonstrated. In 1876 news of the Centennial was transmitted between Philadelphia and New York at a rate of speed at the time unheard-of in telegraphic exploits. By the Edison automatic method the number of words sent in a minute varied from 500 to 5,000, a speed of from 1,500 to 2,000 being easy. A message of 1,000 words was sent from Philadelphia to Sir William Thomson in New York in 56 seconds, every word of it being received clearly and accurately. At other times, when the need of absolute accuracy was not so great, 2,000 and 3,000 words per minute were frequently transmitted for several minutes in succession. In the same year dispatches were sent daily between New York and Bridgeport at a rate of fully 3,000 words in one minute. Between Pittsburg and Buffalo, also, a speed of from 1,000 to 2,000 words was regularly maintained. After the close of the Centennial there seemed to be less demand for extraordinary telegraphic communication, and the Edison method fell into disuse. A great objection to it was that a grounding of the wire would clip out great portions of the message. There are, of course, many difficulties to be overcome before the new system can be introduced commercially, but those who are engaged upon it consider that none of these obstacles is insurmountable. They hope satisfactorily to solve the problems involved.

Barrett Forced to Resign.

John P. Barrett has been forced to resign the position of superintendent of the City Telegraph Department of Chicago. The resignation was not a voluntary act, but was in compliance with a demand from the mayor. Barrett, it appears, was wholly unprepared for this action, and at first showed a disposition to bluster and make a fight, but he was soon given to understand that Mayor Harrison was inexorable, and that, unless the resignation was promptly forthcoming, he would exercise the power of removal given him by the civil service law according to the interpretation of Corporation Counsel Thornton. Finding threats and entreaties alike unavailing to secure even a respite, Barrett reluctantly submitted.

The developments leading up to this climax in the affairs of the "city electrician" are, for the most part, known to readers of this journal. When the new mayor came into office one of the first subjects that commanded his attention was the condition of the city electrical department. In some quarters Barrett was still credited with sufficient political influence to enable him to conduct his office in defiance of the rules governing other branches of the civic administration, but so flagrant had become these violations that there was a general protest against the further retention in office of one who had exerted such a demoralizing influence. Finally a committee from the Brotherhood of Electrical Mechanics, headed by Charles B. Quealy, waited upon the mayor and laid before him a record of Barrett's official career. This statement showed that the sentiment of the electrical fraternity was against Barrett; that the underwriters had no confidence in him and repudiated the inspection work of his department; that the unjust discrimination practiced by Barrett, as illustrated in the awarding of the contract for fire-alarm boxes last winter, had not only stirred up the electrical trades against him, but had aroused public opinion generally; that his open violation of the rule requiring bids for all city contracts amounting to $500 had been a drain upon the city, and that finally he had discriminated against organized labor, and in defiance of the civil service law had refused to appoint certain applicants solely because they were members of the Brotherhood of Electrical Mechanics. In support of these charges the committee presented abundant evidence of a convincing character; prominent citizens, well-known business men and representatives of different branches of the electrical business supported the movement.

On Wednesday, April 21st, the mayor took the subject under advisement, and announced that he would give his decision in a week. At the expiration of the allotted time the decision was announced in a curt note to Barrett, demanding his resignation. After an unsuccessful attempt to secure a respite and with apparent reluctance, Barrett submitted his resignation, thus ending his public career by being driven from office after 31 years on the city's pay-rolls.

Banquet of Chicago Electrical Men.

It will be remembered that at the recent dinner of the Chicago electrical fraternity at the Union League club it was determined to keep up the meetings, and for this reason the chairman of the last banquet committee was authorized to make arrangements for another dinner. These preparations have been concluded and the date announced. It has been decided to hold the next dinner at the Union League club, on Wednesday, May 12th, at 6:30 P. M. The committee having the arrangements in charge is composed of B. E. Sunny, Charles A. Brown, Samuel Insull, W. H. McKinlock, Angus S. Hibbard, W. J. Lloyd, Charles T. Page and F. B. Badt.

Electrical Steering Machinery.

The use of electric power on shipboard is being extended to nearly all the functions formerly performed by auxiliary steam engines, and it is to be expected that the steam steering engines will prove no exception. The *Elektrotechnische Zeitschrift* gives an account of Essberger's electric steering gear, showing very clearly its arrangement and operation. The principle upon which this gear operates is that of two continuously-running motors coupled to an epicyclic train of gearing in such a manner that, when both motors run at the same speed, the motion of the final wheel is zero, but for any difference in speed the shaft is operated in one direction or the other. This "over-running," as it may be called, can continue only so long as the lever upon the bridge is moved, as otherwise a resistance interposes to check the overrunning motor, much in the same manner as the action of a steam steering gear is controlled.

Among the advantages of the electric gear, the greatest, of course, is the absence of the necessity of any mechanical connection between the bridge and the motor room; and the motor portion of the apparatus can be placed as near the rudder as convenient, the wires being readily run to the desired point of control.

It is also an improvement to have the motors continuously in motion. The rudder of a ship may require to be moved several thousand times a day, and the constant reversal of the engines forms a great part of the wear and tear upon a steam steering gear. Essberger's apparatus is now being introduced and tested in the German navy, and similar devices doubtless will be tried soon in the merchant marine.

Alexander Dow to Test the West Park Lighting Plant.

Much difficulty has been experienced in the operation of the new arc lighting plant installed under the supervision of Forée Bain at a cost of $180,000 for the illumination of the West Side parks and boulevards in Chicago. The dynamos are 150-lighters, seven in number, and to these the trouble is attributed by Mr. Bain, who has given his best thought and effort as an engineer to the park commissioners, and who is confident that the plant, in other respects is all right. This is shown conclusively, he thinks, by the fact that a machine of another manufacture was connected at the power house, for a test, to one of the long circuits, carrying the load successfully and without trouble. Mr. Bain insists that the dynamos shall be made right, if it is possible, before they are finally accepted by the board of park commissioners, and this the contractor is, and has been for several months, trying to do. The manufacturing company admits that the arc machines were faulty, but claims that they were not altogether to blame, and were not cared for properly, and that now, with new or rewound armatures and other changes, they are equal to the work required of them under the specifications.

In this situation the present board, which is a recent creation of Governor Tanner and has taken charge since the practical completion of the plant, acting on the advice of its attorney, has concluded to employ a disinterested and independent engineer to make a test of the electrical plant and make a report, so that no injustice may be done to anyone. This report, with those of Mr. Bain, will form the basis of the board's action in relation to the acceptance of the dynamos. For this work Alexander Dow of Detroit has been retained. Mr. Dow is an experienced and capable engineer, whose fairness no one questions. He was formerly the electrical engineer of the Chicago office of the Brush company, and while in this city installed the plant in Washington Park which furnishes light to the South Side parks and boulevards. He afterward accepted the position of city electrician of Detroit, resigning not long ago to accept a responsible appointment with the Edison Illuminating company of that city.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Mississippi Valley Telephone company's representative met the St. Paul Assembly committee in secret session and had the plans of the company outlined. The ordinance granting the company a franchise will be considered at an early day. This company proposes a long-distance line from Keokuk, Iowa (its home), to the Twin Cities and claims to have contracts for about 8,000 instruments in cities where franchises are assured. Every one of these is to be in operation by the first of next year. Work has been begun on the company's plant at Burlington, Iowa, and is being rushed. At Keokuk the Retail Grocers' association has voted to order out the Bell telephones and use only the Mississippi Valley instruments. Other retail merchants pledged the grocers they would follow suit.

Canosia, Minn., voted $400 to aid in the construction of a telephone line from Duluth, Minn., to Pike Lake.

R. R. Pritchard of Princeton, Mo., has completed arrangements for the establishment of a second telephone exchange in Leon, Iowa.

The American Telephone & Telegraph company has been granted a right of way through Black River Falls, Wis.

F. C. Bradbury of St. Paul will establish a telephone system in Wadena, Minn., with lines to Verndale and Park Rapids.

The E. H. Martin Telephone company, Webster City, Iowa, is an applicant for a telephone franchise at Eagle Grove, Iowa.

The Northwestern Telephone Exchange company's new exchange building in Minneapolis is approaching completion. The operating room and switchboard, it is announced, will be the finest in the world.

Public Lighting in Des Moines.

Press and people in Des Moines, Iowa, have devoted much attention to the prospect of establishing a municipal plant for electric street lighting. The city has been expending $55,000 a year for street illumination, and it is asserted that the money can be profitably invested in a city plant. Frank B. Rae of Chicago was retained as consulting engineer for the city, and the matter was discussed with great energy and heat. Finally, specifications were issued for a proposed municipal arc lighting plant, and bids were invited on two plans—one for combined tower and low-lighting and one for all low-lighting in the usual fashion. Des Moines includes within the corporate limits quite a large area of outlying territory, sparsely built, and it is to light this that the tower system is seriously considered, although the point has has not been decided. The Board of Public Works has decided to accept the bids of the McCaskey & Holcomb company of Springfield, Ill., as the best and lowest. However, according to law and as noted in the specifications, a contract cannot be entered into with the bidder selected by the board as making the best tender until the action is confirmed by vote of the electors of the city. Accordingly, a special election for this purpose is set for May 17th. Two questions will be submitted to the voters. One provides for an expression of opinion as to whether the city should enter into contract with the company named. The other is the formal proposition that the city purchase a plant for electric lighting.

The bids of the McCaskey & Holcomb company thus accepted are as follows: Towers and low lighting, $114,588; all low-lighting, $105,365. This is for the building, machinery, poles or towers, wires and lamps complete. In the low-lighting system there are 500 lamps. If the other plan is adopted there will be 250 lamps on towers and 100 on posts. In order that the present appropriation may serve to pay for the plant, the McCaskey & Holcomb company makes this proposition: It will build the low-lighting plant and operate it, lighting the streets of the city for the period involved, for 67 monthly payments of $4,583 33 each. At the end of the five years and seven months it binds itself to transfer the plant to the city in as good condition as when new, ordinary wear and tear excepted, for the sum of $1. In the case of the tower-lighting plant, the monthly payments (which are simply one-twelfth of $55,000) are to last through a period of six years.

Receiver for Calumet Street Railway Company of Chicago.

The Calumet Electric Street Railway company of Chicago has at last found its way into the hands of a receiver. On Friday, April 30th, Judge Showalter appointed John McKeon, receiver of the National Bank of Illinois, to act as receiver of the road.

This action by Mr. McKeon, on whose application the receivership was granted, was not generally anticipated. No change in the Calumet Electric situation was expected after Judge Showalter entered a decree vesting the ownership of an eleven-twelfths interest in the property in the Illinois National and one-twelfth in Farson, Leach & Co., with the understanding that if the road were sold inside of three years the proceeds were to be divided between the interests on a basis of 91⅔ per cent. and 8⅓ per cent., and that if it required longer than three years to dispose of the property the bank was first to receive its share, reckoned on an arbitrary valuation of $3,000,000, which would amount to $2,750,000.

However, the receivership is a friendly one in every respect. Mr. McKeon decided upon the course only after long consideration, and the position of the Illinois National, as well as that of the railway property, is improved in various ways by it. In the first place, without the receivership, if the expenditure of money for repairs, improvements or extensions happened to rise in excess of the net earnings of the road, it would be necessary to draw upon the funds of the Illinois National, whereas the receiver will be enabled in case funds are needed to secure them on receiver's certificates, which may be authorized by the court. Another advantage of the receivership is that it affords a method of bringing out all claims against the Calumet Electric and adjusting them. Again, it places Mr McKeon in absolute control of the property, so that he cannot be hampered by any disagreeing interest from conducting the road in the best interests of the Illinois National, which holds by far the largest claim against the property, and for the safe conduct of the affairs of which Mr McKeon is solely responsible.

Wirt Alternating Current Short-gap Lightning Arresters.

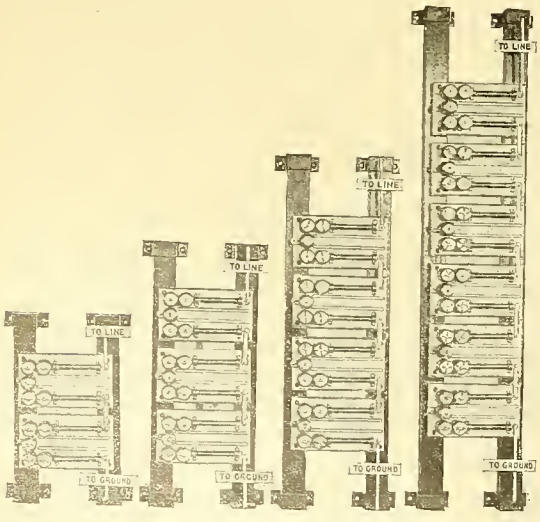
The Wirt alternating current short-gap arresters have been especially designed to operate effectively with very small gap spaces. The arrester for 1,000 volt circuits has but one spark gap of $\frac{1}{32}$ inch between two metal cylinders two inches in diameter and two inches long. One cylinder is connected to the overhead line and the other to the ground, and a low non-inductive graphite resistance is placed in circuit. The combined action of the metal cylinders and non-inductive resistance prevents the heating of the cylinders when the lightning discharge passes across the gap, making the gas which would enable the alternator to maintain the arc. The arc itself is extinguished by the reversal of the alternator current. This arrester is, therefore, not an arc-rupturing device, but actually prevents the formation of an arc. The action is dependent upon the cooling effect of the large metal cylinders, which is increased by the introduction of a non-inductive resistance, and not upon any non-arcing property of the metal itself.

The arrester for 2,000 volt work has two gaps of approximately $\frac{1}{32}$ inch each and a low non-inductive resistance. This arrester will not hold a short-circuit when connected directly across a 2,400 volt alternating current line, but will hold an arc when tested on a 500 volt continuous current line. This proves clearly that the reversal of the alternating current itself extinguishes the arc.

The Wirt arresters are designed for use on alternating current circuits at practically any potential, the standard list including an arrester for 15,000 volt lines. For circuits above 2,000 volts the standard 2,000 volt double-pole arrester has been adopted as a unit, several of these being connected in series for high potential work.

Arresters of this type have been adopted for the protection of the power line connecting Niagara Falls and Buffalo at the power house of the Niagara Falls Power company. An exhaustive test was recently made to determine the proper number of gaps and resistance for a 11,000 volt, 5,000 horse power line. The arrester under normal action only showed a small arc about as large as a pinhead between the cylinders. After many successful tests the proper number of gap spaces was ascertained to be 14, with a wide margin of safety. The gap spaces are each $\frac{1}{32}$ inch.

Arresters of this type are now made by the General Electric company for all alternating current work, and a large number are already in service protecting long-distance transmission power lines having a working voltage as high as 15,000 volts.



WIRT ALTERNATING CURRENT SHORT-GAP LIGHTNING ARRESTERS.

Williamsport Wooden Pipe Company.

Much attention, especially in cities, is now given to the subject of placing electrical wires underground. Appreciating this, N. B. Bubb, general manager of the Williamport (Pa.) Wooden Pipe company, made arrangements whereby the capacity of the company's factory for the manufacturing of wooden conduit was increased nearly 50 per cent.

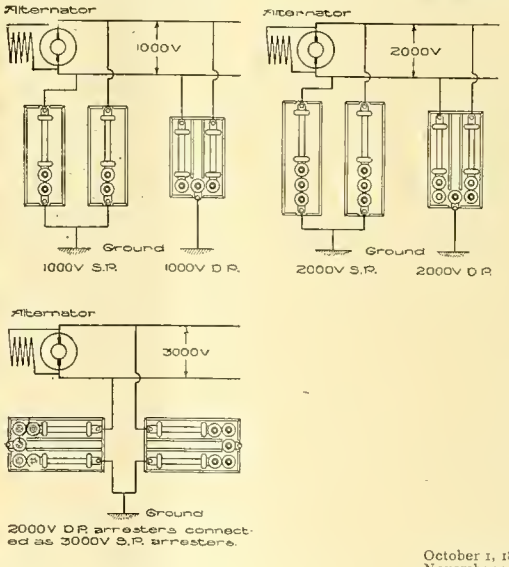
The accompanying illustration shows the present works of this company, which are located at Cammal, Pa., in the heart of the lumber district of that section of the country. This location was selected that the company might have a first selection of the lumber and have it cut especially for its product. After a series of practical tests covering many months, the company now claims to produce an article that stands the test for disintegration better than iron conduit, taking as a basis a wooden conduit that was taken up in Philadelphia and which had been under ground, without any mechanical treatment, for nearly forty years.

The company makes its material from live timber, cut and bored in eight-foot lengths when green. These lengths are placed on trucks and run into a large boiler made especially for this purpose. Live steam at a pressure of 65 pounds is turned on and kept at this rate until all moisture and sap are entirely removed from the wood. The product is then perfectly dry. The next process is the filling of this large boiler with a specially prepared creosote oil, which is forced through the grain of the wooden pipes at 75 pounds pressure until every pore of the wood is completely filled, and an average of 15 pounds of the creosote to the cubic foot is absorbed.

It is found that, after the laying of this pipe in the average soil, owing to this treatment of creosote, the pipe becomes "petrified" as solid as stone and moisture proof; and under such conditions will easily last a hundred years. Some pipe made by this firm three years ago was piled out of doors to note the effect of various conditions of heat, cold and moisture. The result was very satisfactory, there being no warping or decay of any kind, and it is thought there would not be for years to come.

This concern has been doing a very large business, and is now running its plant night and day in order to have stock on hand to fill orders which are already placed. It has over 500 miles of this conduit laid in Philadelphia. The fact that not one length of pipe has thus far been rejected for any cause is a record of which the Williamsport Wooden Pipe company feels justly proud; it substantiates the claim that each length is carefully inspected before leaving the works.

WILLIAMSPORT WOODEN PIPE COMPANY.—WORKS AT CAMMAL, PA.



Some Comparisons Showing the Futility of Free Telephones.

[From the *Michigan Tradesman.*]

The last general telephone directory issued by the Bell Telephone company, in Grand Rapids, was dated May 1, 1896. It contained 25 pages of names—in all 1,800—the highest telephone number issued being 1,448 and the actual number of telephones in service being 1,481. Three supplementary lists have recently been issued, showing new telephones alleged to have been put into service as follows:

	Offices.	Residences.
May 1 to December 1, 1896	22	84
December 1 to January 1, 1897	5	111
January 1 to February 1, 1897	13	64
	40	259

Total in nine months, 299.

As there has been no revised list of the May, 1896, subscribers issued, in order to ascertain the exact number of Bell 'phones in use, the names of all subscribers whose instruments had been removed, to the certain knowledge of the writer, were crossed out, and the remainder determined by crossing out the names of those reported by the operator at the central office as being no longer connected—which methods resulted in showing 660 telephones in actual use on December 1st; and it is estimated that since December 1st the Bell company has lost 120 subscribers, making the present number of connections 839.

Reference to the supplementary list issued by the Bell company this month discloses several very amusing subterfuges which have been adopted to pad out the list and make it appear larger than it really is. For instance, it will be noted that the two telephones in the *Democrat* office are repeated three times each, as follows:

21. *Daily Democrat.*
23. *Daily Democrat.*
21. *Grand Rapids Democrat.*
23. *Grand Rapids Democrat.*
21. *Democrat*, Grand Rapids.
23. *Democrat*, Grand Rapids.

These two instruments have been in service for several years under the numbers "21-1 ring" and "21-3 rings;" and while the change in numbering adds to the list of names, it does not increase the actual number of instruments in service. Because of the difficulty in eliminating the duplicates as here indicated, it is probable that the actual number of instruments in service is less than the 839 already indicated.

A comparison with the figures furnished by the Citizens' Telephone company as to the actual number of telephones in service is of interest:

October 1, 1896	1,554
November 1, 1896	1,635
December 1, 1896	1,698
January 1, 1897	1,770
February 1, 1897	1,813
February 15, 1897	1,837

The Citizens company has not lost a single telephone subscriber because of the free service of the Bell company.

The following comparison is interesting:

Citizens 'phones in use	1,837
Bell 'phones in use, mostly free	839
Excess of independent 'phones	998

Also the following:

The Citizens' company (with competition)	1,837
The Bell company (May, 1896, without competition)	1,481
Excess of independent telephones	356

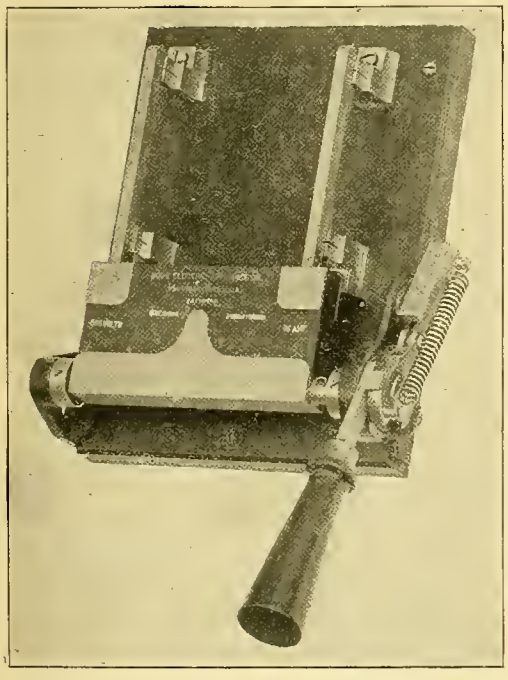
An Instantaneous Make-and-Break Safety Knife Switch.

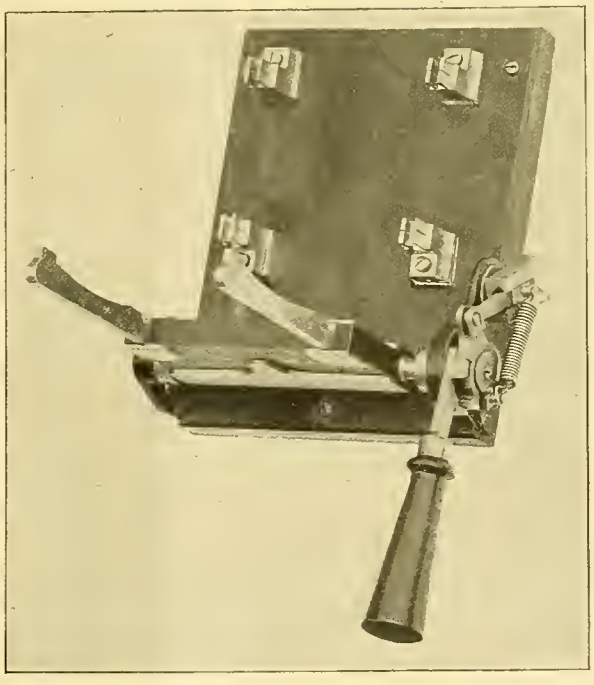
The Hope Electric Appliance company of Providence, R. I., has just put on the market an ingenious double-pole knife switch, which is claimed to be the only instantaneous make-and-break knife switch now before the trade. The illustrations show a style adapted to 500 volt circuits which has a rated carrying capacity of 50 amperes. The mechanism moving the switch consists of a link motion operated by a handle, which puts in tension a coiled steel spring connected to the axis on which the blades revolve. As soon as the spring is brought to the maximum tension, the slightest further movement of the handle starts the blades, and they are immediately thrown open. The same operation in a reverse direction instantly closes the switch. The action is positive, and all four contacts are broken at exactly the same time. This is an important feature. When the switch is in a normal position, either open or closed, the spring is under no tension whatever. If by any chance it should become broken, it does not destroy the quick make-and-break action.

The wearing parts are of dropped forged steel having a machine finish. The blades, which are securely riveted to a block of fiber, are of the highest grade of rolled Lake Superior copper and the contact edges are carefully milled to size. The same metal is put in the brushes, which are of ample size to provide sufficient carrying capacity. Brass composition of the highest conductivity is used in the construction of the posts, that have milled slots into which the brushes are securely wedged and riveted.

The switch is made with the utmost care in order to secure an easy working of the parts, and especial attention is given to the accurate alignment of the blades and brushes. Since the switch is operated only by the action of the handle, it can be set in a sufficiently high position to prevent injury or an accidental short-circuit of the blades, and they can never be thrown out of line by careless handling. The position of the handle at the lower corner of the switch eliminates any danger to the operator, which is especially desirable on high-voltage circuits.

The Hope Electric Appliance company has given special attention to standardizing all the parts, so that any becoming broken can be easily replaced. The switch is mounted on a marbleized slate base, and with the high polish presents a pleasing appearance. It is made in sizes to carry 25, 50, 75 and 100 amperes for circuits of any voltage.

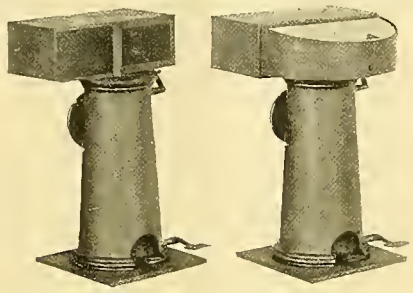




AN INSTANTANEOUS MAKE-AND-BREAK SAFETY KNIFE SWITCH.

Electrical Protection Against Store "Hold-ups."

Daylight robberies of stores, banks and business offices are, unfortunately, of not infrequent occurrence; and to protect the cash in daily use in such places the device illustrated has been invented and patented. This contrivance is known as the "cashier's electric safety cabinet," and in the picture is shown open and closed. The operation of this invention is both mechanical and electrical—mechanical, during the routine of business; electrical, should a dash be made by robbers upon the bank or business house. With this cabinet in use, the funds will be placed inside the cash receptacle, which is always locked by the service mechanism, except when the cashier desires access to it in the ordinary course of business. By a quick and convenient manipulation by the foot, the cabinet opens and remains open just so long as the cashier requires. At the instant the cash receptacle is no longer needed, the cabinet is automatically closed and locked by the day locker, and it remains locked until again needed



ELECTRICAL PROTECTION AGAINST STORE "HOLD-UPS."

In the event of a raid, notwithstanding the fact that the cabinet is locked by the service mechanism, there is an additional protection, which is electrical. Wires are stretched from the base of the cabinet to all points of the store, with push-buttons at every desk and all along the inside of the counters. In the event of a rush by robbers, any employe, by moving his foot a few inches and touching a push-button, can operate the emergency mechanism which locks the machine absolutely; it is then impossible for the burglar to open the machine; neither can he compel anyone else to open it, for it cannot be opened until an instrumentality remote from the bank or business house is applied. At the instant of the emergency locking, in case of a raid, the electric attachment also sets in motion a large gong, the noise of which can be heard at a distance, calling help from every direction.

The device is made in three sizes, weighing 400 to 700 pounds, and is built by the Cashier's Electric Safety Cabinet company of Cleveland, Ohio.

Telegraphic, Telephonic and Mail Service in the United States.[1]

When the extent of the transmission of intelligence at the present time is considered, and the direct influence which this service has upon the development of the world's progress, any proposition which promises to increase its efficiency should be received with consideration.

To better comprehend the volume of this service it is of interest to observe the statistics on the subject. These have been prepared for the United States mail service, the Western Union Telegraph company and the American Bell Telephone company of the United States. The statistics for the United States mail service for the last few years were furnished through the courtesy of the postmaster-general.

It is noticed in general that there is an increase in all departments of the intelligence transmission service from the earliest dates. The number of pieces of mail sent during 1896 was 5,693,000,000, which is the greatest amount ever sent in a single year. The greatest number of telephone messages on record for a single year is 757,000,000 in 1895. The largest number of telegraph messages was sent in 1893 and amounted to 66,000,000. Thus the greatest number of telegraph messages as compared with telephone messages is in the ratio of 1 to 11½. The greatest number of pieces of mail is in the ratio of 86 to 1 as compared with telegraph messages, or in the ratio of 7½ to 1 as compared with telephone messages. It is also seen that the cost of the mail service of the United States in 1896 was $90,626,000, or about $1.25 per capita. The greatest receipts for any year of the American Bell Telephone company were in 1895 $16,400,000, about 25 cents per capita, while the greatest receipts of the Western Union Telegraph company were in 1893 $24,978,000, about 35 cents per capita.

It appears, therefore, that the people of the United States pay for a telegraph service of about $\frac{1}{8}$ the amount about one-fourth of that paid for the entire mail service of the United States. It also costs 1½ times as much for telegraph service as for the telephone service, although the number of telephone messages is about 11½ times as great.

A conclusion to be drawn from this general data seems to be that the people are willing to pay more in proportion for a kind of service like that of the telegraph than any other. From the point of serving the people, as well as from a business standpoint, it appears that improvement in this class of intelligence transmission is at present much to be desired. The present state of the art of telegraphy points to improvements along the line of automatic machine transmission.

It is of interest to inquire what effects a system of telegraphy capable of sending continuously 3,000 words a minute would have on the existing methods. To take a single example of the business between New York and Chicago, where about 40,000 letters are carried daily, it would require but two lines in continuous operation to handle the entire business. At present it takes three days to receive a business reply between New York and Chicago. This transmission by machine telegraphy could be accomplished easily the same day. It is thought that an effect of this would be to increase business transactions to such an extent that the total volume of intelligence transmitted would be augmented, rather than to diminish the business now done by existing methods.

The class of business which such a system would probably at first obtain would be the less urgent telegraph business of greater volume, such as the Associated Press dispatches and newspaper press reports. Among the possibilities is the simultaneous publication of the same newspaper in different parts of the country. For example, in an edition of a daily paper having 12 pages and eight columns per page, making 96 columns in all, there are less than 185,000 words. At the rate of 3,000 words per minute it would only require about an hour to transmit the entire contents of the paper. This calculation furthermore assumes that the whole paper is uniformly printed in fine type. It would require a single operator, working by hand and averaging 20 words per minute, over six days of 24 hours each to send this amount.

The system proposed in this paper is especially adapted to meet the demands of this class of business, for the great flexibility of the alternating current, as employed, permits if necessary considerable amounts of power to be transmitted over the line which may be used for making simultaneous manifold copies of the

1. Abstract of paper by Albert C. Crehore and George O. Squier, before the American Institute of Electrical Engineers, April 21, 1897.

same dispatches in each of widely separated cities. In this manner each of the several newspaper company subscribers in each city receives the identical service with the minimum delay, since each copy received is an original. Each additional subscriber to this service represents no appreciable expense to the company, since it requires but another receiving needle. Furthermore, the use of the alternating current permits the line to be used quadruplex at very rapid speeds, that is, four entirely different dispatches may be sent over one wire at the same time, two in each direction, and any number of copies of one or all the dispatches may be received independently at the same time.

In addition to the above it is practicable to employ the line for a system of the ordinary quadruplex telegraphy at the same time. In trial experiments in the laboratory, particular instructions were given to the operator of the Morse instrument to observe if possible when messages were being sent by the alternating current, and absolutely no effect was detected.

The objection may be urged that it is already difficult to handle the business at the present rate of operation of the Wheatstone system, and if the instruments worked faster it could not be handled. This objection is undoubtedly a real one in some cases, and it is partly this fact which indicates that it may be easier to inaugurate new methods than to attempt to adapt the new rapid transmitters to the present methods.

A telegraph office of the future will probably present a different appearance from that which may now be seen in any of the large cities. At present in operating the Wheatstone system in this country, sending to long distances at the rate of 150 to 200 words per minute, both those who prepare the sending tape and those who translate the receiving tape are employes of the telegraph company and are near the sending and receiving instruments. If it requires about 10 men to prepare tape, and as many more to translate it for a single instrument operating at 150 words per minute, it will require 20 times this working force for one of the rapid machine transmitters. Evidently changes would be required in the present methods to handle this business.

It is thought that a telegraph company of the future will fulfill a somewhat different function from the present ones. The company will own its wires and rights of way as now, but the tendency of the offices proper will be to transmit and receive letters already prepared rather than to undertake the preparation of the letters as well. The income of the company will be derived from the rent of its lines at a fixed price per minute, or a fixed price per hundred words. The service of the telegraph office then becomes like that of the post office, its duty being to receive and deliver letters already prepared, as the postoffice does. The difference between the two offices is in the manner in which this is accomplished. The telegraph office becomes a postoffice which employs an electric current in a copper wire to carry its letters instead of a railroad train. The advantage in point of speed of delivering letters by the former method are apparent. Instead of requiring 24 hours to deliver letters between New York and Chicago, it will require but a few hours at most, and make it possible to receive a reply the same day. It is probable that such a system would take more business from the present postal system than any other, for when telegraph letters can be sent at reasonable rates comparable with postage, in a few hours instead of many days, a certain amount of present postoffice business will be diverted. More than this, when business can be done with greater facility than at present, the total volume of business will undoubtedly be increased, because transactions may take place place in a day which formerly required a week.

It would be to the interest of such a company to seek that class of less urgent business now done by correspondence, rather than the class handled by the present telegraph companies, where the highest speed of delivery is expected. If one trunk line becomes established between large business centers, it will draw business from a surrounding area. For instance, if a line were established between New York and Chicago, and a person in Albany desired to communicate with Chicago or points beyond, it would be quicker to send the letter to New York for transmission over the trunk line to Chicago, and then by rail to its destination, than to send directly by rail from Albany. With a few trunk lines in successful operation it would not be long before they would be multiplied.

It is understood that these telegraph letters are sent by mail in envelopes in the usual manner, except that the envelope contains the prepared message ready to be sent through the transmitter, and thus the telegraph office becomes relieved of the preparation of the letters, which is not strictly a part of its business. When the system comes into general use, business offices will have their own perforators, and it will become necessary for the operator to learn the telegraph alphabet as a part of his preparation as a stenographer and typewriter. The three-key perforating machine is comparatively inexpensive, but undoubtedly a machine could be devised at an early date, as an attachment to the present typewriter, for the purpose of perforating letters at the same time that they are being written by the typewriter in the usual way. This could be constructed to operate by the use of electro-magnets, and could be attached to a typewriter without interfering in any way with its operation. No extra power would be required, for this can be derived from an electric current which operates the attachment. The writing may be perforated at the present rate of speed of typewriting without the operator having any knowledge of the telegraph alphabet as far as perforating is concerned. This machine will cost more than the three-key perforator, but it would in a short time more than pay for the difference in cost on account of the great gain in speed, and also because it prints a copy of the letter which may be kept on file. Before these perforators are introduced into common use it will be necessary to establish offices in the immediate vicinity of the terminals of the trunk lines, to prepare letters for persons furnishing printed or written copy, as well as to furnish a printed translation when desired of letters received from the central office. The opportunity to obtain a cheaper rate for prepared letters will act as an inducement to those employing a stenographer to add a perforator to their offices.

Concerning the daily correspondence of the large business houses between cities which are the terminals of the trunk lines, it might be an advantage for them to have exclusive use of the line for a certain number of minutes daily at a certain fixed time of day, by subscribing and paying an annual rental to the company. Knowing definitely at what hour the mail would be dispatched daily, it would then be possible for each house to send by messenger its daily mail already prepared for transmission to the general transmission office, where it could be placed in boxes prepared for the subscribers, to be taken out and transmitted when its time arrives. The distribution at the receiving end of the line could be accomplished as now by the regular mail service.

In the limited use of rapid automatic intelligence transmission at present, the sending and receiving records are made upon prepared paper in the form of tape. In the larger volume of business which is being considered here, it does not seem certain that tape would be the best form for the sending and receiving paper. It would be an advantage to have the letters received upon sheets of paper with the dots and dashes arranged in parallel lines. Besides facilitating the reading, this form would be more convenient for mailing. It would also easily permit reference to any part of the letter at a glance. The amount of paper required by the use of sheet form instead of tape would be reduced, which is an item of importance where such a volume of business is being handled. Sending and receiving from the surface of a cylinder seems entirely practicable.

Another point which must be considered, is whether with these systems, the induced currents from neighboring wires along the line or from any other cause will affect the legitimate signals materially, as has been at times the case with the Wheatstone system. In reply to this it can be said that these receivers for telegraphy are not necessarily more sensitive to small currents because they are rapid. On the contrary, they may be made to require as much current as is found desirable to rid them of the effects of outside influences, and at the same time retain the property of quick action in response to currents of the proper magnitude. In this connection it may be said that the utility of a single line wire becomes so great that more attention will be given in the future to the line construction and maintenance. If millions of dollars are invested in the construction of a single railroad, is it not as necessary to make the telegraph lines which carry important and profitable business as perfect in their construction?

The telegraph line of the future will comprise substantial poles carrying a few copper wires worked to their full capacity for transmitting electric signals. The cost of maintenance of such a line when once constructed will be little more than for an ordinary iron wire now used, while its carrying capacity for intelligence at 3,000 words per minute simplex will be about equal to 160 wires used for hand transmission simplex. By duplexing the line, the carrying capacity is doubled and becomes 6,000 words per minute, which is about equal to 160 wires worked duplex, or to 80 wires worked by hand quadruplex.

It is thought that the influence which the inauguration of a telegraph letter system would have upon the existing telegraph and telephone business would be to increase rather than diminish it. Each of these services has its own special field of usefulness but little affected by the others. A new field would be occupied rather than an old field supplanted. The present telegraph and telephone would still have their natural field of operation, even though the best hopes for a telegraph letter service are realized.

A single line capable of sending 6,000 words per minute between New York and Chicago becomes a different kind of investment from a long-distance telephone line where the number of words per minute with the fastest rate a speaker can talk is very slow in comparison, and the charge is $9 for five minutes' use of this line.

The application under government control of a rapid system of correspondence transmission such as has been outlined, operating in conjunction with the present postal system, by supplementing and relieving their service, could hardly fail to prove of benefit to the people of the United States. This comes within the proper duty of the Postoffice Department, and would be under the direct control of the postmaster-general. The simplification in operation and expense which would result from uniting directly with the general postoffices of large cities the telegraph letter service would soon be realized by the people and a better service insured.

As a practical means toward ultimately assuming the direct responsibility of this new service, it would probably be easy to secure private companies which would be willing to contract with the Postoffice Department to transmit telegraph letters at a fixed rate for a term of years. In this manner the department could gradually absorb this branch of its busines and be relieved of any sudden new responsibility and radical reorganization.

It is not thought that the development of a rapid intelligence transmission service to the extent suggested could be accomplished before many years, nor indeed that the manner or means of this development should closely follow the lines indicated, but that something analogous to this development seems among the possibilities if not the probabilities of the near future.

The persistent efforts of Mr. Delany and the great system which he has developed are well known, and the ideas which he has advanced in regard to the applications of rapid systems are in the main in accordance with those stated herein.

General Electric Company.

The annual meeting of the General Electric company will be held at Schenectady on May 11th, at which time the annual report will be presented for consideration. "Owing to absence in Europe of the first and third vice-presidents, their annual statements cannot be prepared in time to accompany this report, which is sent out in advance of the annual meeting of stockholders." Such is the announcement that accompanies the fifth annual report. It is added, however, that the missing statements will be prepared and sent out "in due course." The departments under the immediate direction of the absent officers are the sales department and the manufacturing and electrical department. President Coffin's report to the stockholders is appended:

The business of your company has suffered during the past year, in common with that of all manufacturing enterprises, from the disturbed financial and political conditions which have prevailed during a considerable portion of the time. These conditions have curtailed the amount of capital ordinarily available for the establishment and extension of power and lighting plants, and have enforced the practice of great economy on the part of its customers. As a result, the shrinkage in orders received by your company was very marked, especially during the latter half of the year. This shrinkage is not shown by a material falling off in shipments, as given in the profit and loss statement on page 17 of this report, but the amount of work in progress and unfilled orders on hand is considerably less than a year ago.

With a return to normal commercial conditions, a corresponding revival in the business of your company may be expected. The volume of business secured by it for the first three months of the current year is slightly in excess of that for the same period in either of the three previous years.

On January 31, 1895, the sum of $2,000,000 was set aside, as shown in the annual report of that year, to provide for shrinkage in assets, exact values of which it was then extremely difficult to fix. During the past year your directors have been able to value these items with substantial accuracy, and the $2,000,000 fund has been found sufficient and has been used to provide for the proper adjustment of all accounts and other assets for which it was created.

BUSINESS OF THE YEAR.

Gross earnings		$12,820,395.87
Less expenses		11,207,388.65
		$1,613,007.22
Deduct—		
Interest on debentures[1]	$ 431,250.00	
Less interest and discount, and interest and dividends received on securities owned	370,479.70	
		60,770.30
		$1,552,236.92
Deduct amounts written off—		
Sundry losses and allowances for possible losses	$ 318,531.13	
Patents	349,919.20	
Inventories and consignments	61,084.36	
	$ 729,534.69	
Less—		
Profit on securities sold and debentures canceled	136,955.85	
		592,578.84
Reduction of the deficit of previous years		$ 959,658.08

Additional purchases of your company's debenture bonds have been made during the year to the amount of $750,000, leaving now outstanding $8,000,000. All debentures purchased have been canceled.

The decrease in the amount of interest and dividends received, as compared with the previous year, is due largely to the cessation of dividends by the Canadian company, which it is hoped will soon resume dividends on its reduced capital. As a partial offset there has been an increase in the income derived by your company from dividends on stocks held by it in various local companies.

PATENT LICENSES AND PATENT LITIGATION.

In the last annual report attention was called to an arrangement which had then been concluded with the Westinghouse Electric & Manufacturing company for an exchange of licenses under patents owned and controlled by the two companies. Your directors are pleased to report that the result of this arrangement has been highly satisfactory.

The result of the work of your company in protecting its patents and enjoining infringers thereof has been especially encouraging, and a considerable number of patents of value has been acquired by it during the year.

The courts have invariably recognized the validity and controlling importance of the Vandepoele patents on the electric railway trolley and switch system, and at the present time substantially all manufacturers of infringing trolleys and switches are under injunction. The company has met with no reverses in its patent litigation during the past year.

Many new suits have been brought, involving important patents, and are now being actively pushed.

1. On $8,750,000 for 10 months and on $8,000,000 for two months.

SALES, FINANCIAL AND MANUFACTURING DEPARTMENTS.

Attention is called to the reports of the first, second and third vice-presidents, containing much valuable information with respect to their various departments.

The great improvements made by your company during the past year in the design and construction of its apparatus have been very satisfactory. The development in long-distance transmission of electricity and the progress made in electric railway service have been especially noteworthy. Many new enterprises, involving the application of electricity to railways now operated by steam, are under consideration, and the ensuing year promises to be marked by a very rapid growth in that field of work.

Your company has added one large factory of brick and steel construction to its plant in Schenectady during the year, besides completing and occupying another, which was commenced in 1895. Other important improvements at these works are in preparation, designed to add to the facility and economy of handling their output.

The report of the second vice-president includes the tabulated statements herewith given.

In the detailed statement, a list of the principal securities held by the company is given. It contains many items that will be recognized at once as "old friends" by those who have had occasion to examine former reports or who are familiar with the financial transactions of the company.

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1897.

ASSETS.			LIABILITIES.		
Patents and franchises		$ 8,000,000.00	Capital stock:		
Factory plants		3,400,002.00	Common	$30,460,000.00	
Real estate (other than factory plants):			Preferred	4,252,000.00	
Edison building, New York City	$ 412,584.63				$34,712,000.00
Other real estate	230,431.61				
		643,016.24			
Stocks and bonds		8,545,795.68			
Cash		703,483.84	Five per cent. gold coupon debentures		8,000,000.00
Notes and accounts receivable	$4,578,600.96		Accrued interest on debentures	$ 66,666.65	
Work in progress	517,866.30		Accounts payable	402,264.81	
	$5,096,467.26		Mortgage on Edison building	200,000.00*	
					668,931.46
Inventories:					
Factories	$3,375,511.07				
General and local offices	621,489.32				
Consignments	37,752.65	4,034,753.04			
		9,131,220.30			
Profit and loss		12,957,413.40			
		$43,380,931.46			$43,380,931.46

* Paid off February 26, 1897.

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1897.

EXPENSES.			EARNINGS.		
Balance January 31, 1896		$13,917,071.48			
Cost of goods sold	$9,691,501.12		Sales	$12,540,993.88	
General expenses and taxes	1,515,887.53		Royalties and sundry profits	279,401.99	
		11,207,388.65			$12,820,395.87
			Dividends and interest received on stocks and bonds owned	$ 282,143.69	
			Interest and discount	88,336.01	
					370,479 70
Interest on debentures		431,250.00			
Sundry losses and allowances for losses	$ 318,531.13		Profit on sales of stocks and bonds	$ 79,816.76	
Depreciation of inventories	50,354.85		Discount on debentures purchased and cancelled	57,139.09	
" " Consignments	10,729 51				136,955.85
		379,615.49			
Patents and patent expenses		349,919.20	Balance January 31, 1897		12,957,413.40
		$26,285,244.82			$26,285,244.82

COMMUNICATIONS.

English Electrical Journals.

To the Editor of the WESTERN ELECTRICIAN:

I observe that on page 246 of your last issue, you have an article referring to the relative ages of your two British contemporaries, the *Electrical Review* and the *Electrician*, both of London. In view of the apparently conflicting statements which have been made, it is not surprising that the question, Which of the two was the first journal to appear? is something of an enigma.

I happen to possess the first volume of both, and can give you the facts. The *Electrical Review* appeared first as the *Telegraphic Journal and Electrical Review* in 1872, No. 1 of Vol. I. bearing the date of November 15, 1872, and as the consecutive numbers of the volumes and issues have been carried on up to the present time, there can, I conceive, be no question that this journal is entitled to its claim that the present *Electrical Review* is in fact the same journal as that which originally bore the double name of the *Telegraphic Journal and Electrical Review*. No one would dare to say that a man has changed his identity because in his mature life he may have chosen to drop one of the several Christian names given to him by his "godfathers and godmothers in baptism."

The *Electrician* does not go farther back than 1878. No. 1, Vol. I., of that publication is dated May 25, 1878; and every editorial line of that issue shows that it considers itself to be the first of its race. Its prospectus begins as follows: "The want of a weekly paper devoted to the consideration of electrical subjects has long been felt, and we venture to attempt to supply the want." And the same suggestion, differently stated, is also to be found at the beginning of the first leading article on page 6.

It is true that a number of years prior to this—that is, in the early sixties—there had already been a weekly journal bearing the same title, viz , the *Electrician*, but this had gone out of existence long before, and certainly the present journal cannot by any sensible person be regarded as a continuation of the earlier *Electrician*, which had lived an ephemeral life, and had passed totally out of existence.

I have never been able to obtain a copy of this earlier paper, but think that I have seen somewhere a statement that it started in 1861, and did not exist more than two or three years at the outside. It is mentioned in the celebrated Ronald's Catalogue of Electrical Books as "*Electrician*, The. A weekly journal of telegraphy, electricity, etc., 4to. London, 1862."

THOMAS D. LOCKWOOD.

Boston, April 30, 1897.

Competitive Telephone Interests.

To the Editor of the WESTERN ELECTRICIAN:

I have, at various times, been asked to contribute something in the way of telephone history, and more recently to supply something in the way of general information, or a review of competitive telephone interests. There are many in the telephone business to-day who possess an ability for presenting these matters in a more forcible manner than myself, but, viewed from a standpoint of experience and absolute knowledge, gained through nearly twenty years of constant telephone work, there are few who are better qualified to know whereof they speak.

During the summer of 1878, when there were, perhaps, a half a dozen telephones in service in the city of Chicago, I entered the employ of the Bell Telephone company of Boston. H. H. Eldrid was then general agent, located at Chicago, where my experience began and where it ended, so far as the Bell company was concerned, with the Chicago Telephone company, January, 1894. During 1894 and the early part of 1895 my efforts were directed toward the building up of a magneto telephone interest; not that I had confidence in its eventual success, but at that time capitalists were afraid to invest money in the manufacture of battery transmitters. During the last two years I have pretty thoroughly covered the country, in serving the company with which I am connected, in the interests of competitive telephone exchanges. I have gained much experience, or, I might say, I have reviewed a part of my earlier experiences in my endeavors to assist those who have had the determination and good sense to invest money in a money-making business at a time when the more doubting were frightened off by the Bell company's published and oral statements of a misleading character, and, as a rule, misrepresentation of facts. This brings me to the subject in hand, and with which I propose to deal at some length.

A communication under date of March 15, 1897, from one of our best customers, reads as follows:

I enclose clippings which will explain the kind of literature that the Bell company is circulating among its telephone users in ——, and there is not a week that more or less of this kind of literature is not being circulated, first, by appearing in the columns of some local paper, marked copies of which are sent to all telephone users. The purpose of this matter, originally, was to prevent persons from signing our telephone contracts, but upon reading these clippings you will see that their aim is to prevent would-be investors. All of this matter has been of advantage to us, as it has kept us before the public, and has convinced the telephone user that our proposition must have merit, or it would not have been so vigorously attacked by the Bell company.

The clippings referred to will not be dealt with at length herein. One is a copy from *Electrical Engineering* of recent date, a bright little electrical journal which has devoted much time and effort to contributions from prominent Bell telephone writers, and whose editor assured me personally, not long ago, that a great many thousands of copies of the little work which he was publishing had been ordered by the Bell company's representatives for wholesale distribution.

One of the clippings in question presents a very gloomy treatise on the subject of "Rival Exchange Installation." It winds up by citing 24 failures, which occurred principally during 1895 and 1896, according to dates furnished. Let us review the situation as pertaining to the 24 exchanges which the writer of the article states have gone out of existence. They are: Jefferson, Texas, population, 3,000; Memphis, Mo., 1,780; Ridgefield, Conn., 1,650; Argus, Ind., 1,500; Madisonville, Ky., 3,500; Sayville, L. I., 1,600; Far Rockaway, L. I., 2,300; Highland Park, Ill., 2,700. The small population at these points is in itself a sufficient explanation for a discontinuance of a telephone system where making money was the objective feature, because in an exchange organized for such a purpose an operator must be employed and rent paid, together with other expenses of maintenance. Or, to put it differently, where the population is so small that one cannot secure at least 70 subscribers, the net profit would not be sufficient to warrant the investment, conditionally; a co-operative company of 50 subscribers can be, and is, without question, successfully conducted in small towns. I presume the company which I represent has sold to nearly 50 different exchanges apparatus for the installation of 25 to 50 telephones, and, in every instance, we find that from the manner of operation the revenues received are satisfactory, or at least the benefits to co-operative interests are all that could be asked. This satisfactory condition is accounted for, to some extent, in the fact that a small switchboard can be located in a drug store, hotel or office about town, and operated with nominal expense to the company. The calls are not frequent, and experience has proven the ease and simplicity with which a little exchange of this character can be operated if properly treated in the beginning, which was not true of the towns just mentioned. Referring again to the article, we find mentioned Great Barrington, Mass., with a population of 4,750; Nevada, Mo., 7,500; Waukesha, Wis.; 7,200; Big Rapids, Mich., 5,300; Uhrichsville, Ohio, 6,000; East Liverpool, Ohio, 13,500. In cities having a population of from five to ten thousand, a fine paying telephone plant may be installed successfully and operated at rates not exceeding $2 50 per month for business telephones and $1.50 per month for residence 'phones, and pay a dividend to the original investors of not less than 15 per cent. If there are any who doubt this statement I will produce positive evidence as to its reliability, and can refer doubting ones to exchanges which are making at the present moment not less than 25 per cent. on the original investment after deducting maintenance and operating expenses, of course, while some of our exchange managers claim to be making as much as 35 per cent. It is to be borne in mind that in cities of this size the number of subscribers, at these rates, will average a 'phone to every 35 inhabitants. In Madison, Wis., the Dane County Telephone company is operating an exchange to-day having a total of 720 subscribers, an average of one 'phone to every 25 inhabitants. The rates charged are $2 a month for business and $1.50 for residence telephones under three and five year contracts. The Wisconsin Telephone company's exchange at Madison, at the time the Dane county began operation, numbered a total of about 250 subscribers, and has steadily decreased since the installation of the Dane County Telephone exhange. The service given by this company to the Madisonians is a revelation and is far superior to that originally furnished by the Wisconsin company at that point. This is only one of many instances I might cite. Before dismissing Madison, however, I wish to say that the Dane County company is making money, and, for that matter, so is every other exchange which has been properly managed, and which we have supplied with apparatus. I know of no single failure among all our customers. The towns which I have named, and others which go to make up the list of 24 were all supplied with apparatus of very inferior character, so far as we can learn, many attempting to operate with the old magneto 'phones, automatic systems and with the Harrison transmitter and auxiliary apparatus. Many of the towns in question used a very crude form of battery transmitter, imperfectly made, and utterly unreliable. Many of the cities which are represented to have failed did not even get so far as a beginning. The second largest failure indicated, that of East Liverpool, Ohio, for instance, never installed a competitive telephone; a subscribers' list had been secured which was afterward turned over to the Bell company. It is stated in the article which I have under review that these points have all proven failures. Fort Smith, Ark., population 16,500, is also mentioned. This was an original Harrison exchange, and the electrical reading world at large is pretty thoroughly acquainted by this time with the Harrison company's experience. La Grange, Ill., population 4,500, is also named. This exchange the writer happens to know personally was originally installed with magneto telephones, and the wires were strung on electric light

poles; probably their money was all expended in an endeavor to make a system of this character a satisfactory one. Summerville, N. J., population 4,500; Clarksville, Tenn., population 8,000; Augusta, Me., population 10,000; Pittsburg, Kan., population 10,000; Ypsilanti, Mich., population 6,100, and Fayetteville (we do not know which one), may be considered in the same class as those exchanges cited, and, referring to which I quote from a number of letters received in reply to the following inquiry:

You will at once note that we are telephone manufacturers and dealers. Our present inquiry is with regard to the statement recently made in the Bell company's interest and very generally published with a view to discourage competitive enterprise. We believe the statements made are at variance with the facts in each individual case, and desire to secure some reliable information on the subject. The question we would like answered is this: What occasioned the failure of the rival telephone company operating in your city and reported to have suspended operations in ——? We enclose stamp for reply, and thank you in advance for your courtesy, and ask, in conclusion, that if you cannot answer the question you will kindly hand this to some one who has knowledge of the facts.

Answer 1. (Memphis, Mo.) Parties putting in telephones were irresponsible, and the whole thing was of little account and failed to work in a few months. I do not know whether it was a rival to the Bell or not. We now have no system.

Answer 2. (Selma, Ala.) While the telephones used by the late competitor of the Bell company in this city were not perfect in every particular, we think it was for lack of first-class construction, and especially want of such close management of the system as the Bell company maintains. The competitive company was getting 'phones into fine shape and was making itself so severely felt that the Bell company bought it at a price.

Answer 3. (Waukesha, Wis.) The cause of the failure of the National Telephone company in this city seemed to be due to incompetency on the part of the management. The electrician did not understand his business and failed to keep the plant in running order. The citizens gave it moral and financial aid and it should have been a success.

Answer 4. (Great Barrington, Mass.) From inquiry and upon belief, my answer would be lack of patronage and largely failure to supply outside communication.

Answer 5. (Ubrichsville, O.) Lack of funds seemed to be the reason of the failure of the rival telephone company which was in course of construction in our village. Their poles and wires and the one or two 'phones they had invested were levied upon, appraised and sold at public outcry to pay the laborers. They did not get so far as to operate in our county until they were levied upon and sold out. Wish a rival company would come here and commence where these people left off and complete a rival line. I think it would certainly be a good investment.

Answer 6. (Nevada, Mo.) Some of their patrons were not satisfied with the service, while others were perfectly satisfied. They claim to have had about 100 subscribers at the time they suspended. It may have been lack of money that caused the suspension. I know that at the time of their suspension they owed their manager something like $250, for which he sued and attached their plant or franchise. His name is —— and he is now employed by the Bell company.

Answer 7. (Big Rapids, Mich.) The telephone company you speak of did not fail; they sold out to the company that was here, and the proprietor of the company became manager of the company which is here at present. The Bell company is the only company with the exception of the one mentioned that has ever operated here.

Answer 8. (East Liverpool, O.) There has never been any other telephone company in operation in this city except the Bell company. An effort was made a year or so ago to have the Phoenix Telephone company of Indianapolis come here, and a list of 200 subscribers was secured, but the company failed and the majority of subscribers were turned over to the Bell company.

I have selected these letters from the total number received as showing very generally the complete situation. In dealing with a few individual instances, we are apt to lose sight of the most prominent and pronounced factor in connection with the reported suspension of the exchanges in question, and that is, the very small percentage of failures cited during 2½ years of financial depression, a condition or affairs which has not only sent to the wall some of our finest and most prominent commercial interests, but closed the doors of a number of our leading banks all over the country. I recently read an article published in one of the eastern electrical journals, in which the writer cried "Look out for the bear," and referred to the operation of possibly one or two hundred exchanges which had been established in opposition to the Bell, and apparently showing the great expense involved in the first cost of a telephone exchange. I speak of this only from recollection; I may not literally quote the writer, but, reference will show such to have been the general character of his article. Now what is the actual situation? We will not indicate by names, but will style the various companies, good, bad and indifferent, who have and who are still selling telephones, by number: Company one claims to have installed over 325 dividend-paying exchanges; company two claims to have installed over 275 dividend-paying exchanges; company three claims to have installed over 300 dividend-paying exchanges; companies four, five, six, seven and eight have a total of 700, making a total of 1,600 exchanges, and over 1,500 of this number are in successful operation to-day. Let me ask again what 24 failures in such a business indicates, when we come to compare it with other lines of commercial investment, and the list of failures to be singled out from any one branch, and a similar comparison made during the years in question?

Realizing from long experience the absolute folly of indifferent construction, cheap apparatus and inexperience of men employed to build and care for exchanges, it has been my object from the first to present this matter to prospective investors in a thorough manner. I have always placed much stress upon the necessity of buying only the best, and employing as superintendents and managers men of experience in the business, and perhaps the greatest proof of the carrying out of these ideas is found in the fact that every exchange installed by the Standard Telephone & Electric company to date is in operation, and has proven a satisfactory investment to the promoters. Possibly in one or two instances a reconstruction has been necessary, which has deducted from the profits somewhat. One of the greatest proofs of the earning capacity of an exchange, which I call to mind, is in connection with a somewhat prominent rival telephone concern which undertook to construct a $60,000 plant with $30,000. They managed to buy their line material and construct their lines for the $30,000, and were successful in procuring apparatus for the plant with a small additional outlay. The $30,000, amount of indebtedness on their hands when the exchange began operation has been very nearly paid in less than three years, and there is now no question but that another year will see the plant entirely free from debt. This means that the exchange will have earned 25 per cent. on the original $30,000 invested. It is true that it also means that the manufacturer and dealer have waited a long while for their money, but the conditions were such three years ago that manufacturers were really obliged to accept considerable risk as to payment on the sale of apparatus. I am happy to state that this condition no longer prevails. The company I represent has established a reputation for quality, workmanship and fair dealing which renders it no longer necessary to furnish goods on small cash payments with unsecured paper.

As a further proof of the advance of the rival telephone interests of the country, I quote a few questions, together with replies received recently from a number of telephone exchange companies. We have received many hundreds of replies of similar character, but simply quote from a few exchanges of 400 subscribers each and less.

Question: When did your exchange begin operation?

Answers: (1) January 1, 1896. (2) August 1, 1895. (3) July 1, 1895. (4) December 1, 1895. (5) June, 1896. (6) September 1, 1895. (7) July 1, 1896. (8) July 1, 1896. (9) May 1, 1895. (10) August 1, 1895. (11) October, 1895. (12) July 1, 1894. (13) October 1, 1895.

Question: How many subscribers at present?

Answers: (1) 90. (2) About 60 or 70. (3) 225. (4) 172. (5) 118. (6) 59. (7) 74 and 50 more in sight. (8) 55. (9) Toll lines. (10) 266. (11) 775 in three exchanges. (12) 100. (13) 75.

Question: What is the cost of your exchange to date per subscriber? that is, divide your total cost by the total number of subscribers.

Answers: (1) About $21 each. (2) About $15. (3) $61; one-tenth of our 'phones are on toll lines. $(4) $43.33. (5) $30. (6) $50. (7) We sold telephones direct to each subscriber, making cost of exchange that much less. (8) Expense of building toll and exchange lines was not kept separate; cannot give figures, probably $20 per mile, equipped. (9) Toll lines. (10) $50. (11) $40. (12) Cannot answer. (13) Actual cost has not been $50 per number since I started; I spent probably $100 in making changes on line.

Question: Are you making any money? If so, what net per cent. on the actual cost of your plant? (While we should like very much to know just what you are doing, it will be satisfactory, if you prefer to simply state that you are making money, and are well satisfied with the investment.)

Answers: (1) I am making money and am not for sale. (2) About 35 per cent. (3) 25 per cent. (4) 20 per cent. (5) A good per cent. on investment and satisfied. (6) Making money. (7) We are making money and are perfectly satisfied with the investment. (8) 20 per cent. last year. (9) We are doing very well. (10) Dividend satisfactory to all. (11) 20 per cent. or more. (12) Constructing now, making money for future. Satisfied. (13) This plant is netting me —— on investment, but do not want it known.

Question: Do you consider the telephone which you are using to be as satisfactory in talking qualities as the instruments used by the Bell company?

Answers: (1) The poorest one I have works better than their best one which they have in here. (2) Yes, and more so (3) The exchanges are fully as satisfactory, and I think they are for toll lines. (4) Yes; our patrons consider it superior. (5) As far as is known it is better. (6) Superior. (7) We consider the telephone we use superior to the Bell. (8) The Standard is superior to the Bell. (9) In every particular. (10) Far superior and has the advantage of not requiring adjustment. (11) We are using the Mildé (Standard) which is far ahead of the old Bell. (12) Are not acquainted with the Bell telephones. (13) Our instruments are far ahead of any 'phone I have tried yet of Bell company.

Question: Are you furnishing a more satisfactory service to your subscribers than that heretofore furnished by the Bell company?

Answers: (1) Yes, in every respect. (2) Not represented here: (3) We are not in same town with Bell, but many men who have used both say our exchange is better than Bell exchanges. (4) Yes; we are. (5) Yes. (6) Yes. (7) No Bell telephone here, and none wanted. (8) The Bell never had an exchange here; we rented of them. (9) Toll lines. (10) Yes. (11) We are. (12) No Bell company here. (13) The Bell is not in it here.

Question: Do you find it difficult to talk over toll lines?

Answers: (1) No, sir. (2) No. (3) No. (4) No. (5) Have none at present. (6) No. (7) No difficulty whatever in talking over toll lines. (8) No. (9) Not at all. (10) No; get the best of service. (11) No more so than over Bell lines. (12) Do not over our lines. (13) Not at all.

Question: What is the greatest distance you are carrying on business over these toll lines?

Answers: (1) 35 miles. (2) About 60 miles. (3) As far as 150 miles. (4) 18 miles. (5) ——. (6) 11 miles. (7) 30 miles; will soon be talking over nearly 60 miles of toll lines. (8) 70 miles. (9) 150 miles grounded circuit. (10) 19 miles through three boards. (11) 50 miles. (12) 50 miles. (13) 18 miles on one line.

Question: How many more telephones have you in service than the Bell company had before your exchange was installed?

Answers: (1) 30. (2) 60 or 70. (3) Not in this town. (4) 117. (5) 115. (6) 19. (7) No Bell 'phones. (8) We rented six from the Bell company. (9) Toll lines. (10) 78. (11) From four to six times as many. (12) No Bell company. (13) The Bell has never been able to do business here; only two or three instruments.

Question: How many paying telephones do you estimate the Bell company has in operation?

Answers: (1) Between 80 and 90; they have 135 in all together. (2) Not any. (3) Don't know. (4) Not one that I know of. (5) Three. (6) None here; 35 telephones. (7) None. (8) ——. (9) ——. (10) 80 free telephones; none are paying rental. (11) One-quarter our number. (12) No Bell company. (13) Two and toll station.

Any additional information that you may be pleased to furnish will be treated confidentially or otherwise as you may direct. Many replies were received in answer to this offer, some of which are given:

(1) We have an exchange near here of 20 numbers which compares with the Bell; same as here, they are losing subscribers right along. (2) We have tested several other 'phones and found none as good as the Standard; we consider them the best in this country. (3) I believe the local exchanges will displace the Bell exchanges, and in time, as soon as the local companies can construct long-distance lines, they will displace the Bell in them. (4) The Wisconsin Telephone company has been giving free service from the time we first entered the business, but has lost all important connections. (7) We can prove to anyone interested that there is good profit in a telephone company rightly conducted. (8) Our exchange is working so efficiently that we expect to put in a 100 drop board this season. (10) The Bell company, through its medium, has circulated some misleading pamphlets, but these are of no avail, as our company is prospering, thus showing the falsity of their statements. (11) There never was as favorable a time to invest in the telephone business, but the telephone business can no more be neglected than can a railroad; success depends on work. A telephone exchange is not like a clock, to be wound up and left to run down. (12) We have two exchanges and about 60 miles of toll line.

I have gone into this matter at some length, believing it to be in the interest of all parties concerned, except, possibly, the Bell Telephone company. I say "possibly," because it seems to me it would be better for them to co-operate with these local exchanges, and by so doing increase at least toll-line earnings without much, if any, additional investment, and in condescending to do this they would naturally exert a good influence as to the quality of apparatus used, which in itself would serve to kill the class of dealers who at the present time are handling an inferior apparatus, or whose methods of apparent fair dealing win upon the confidence of investors, oftentimes seriously. The suggestion, however, is apparently useless, as it seems to be the Bell company's intention to hamper rather than assist. This is not questioned, as the laws of competition are, and have been for many years, thoroughly established. However, competition should be fair, and misleading statements withheld.

In conclusion, I touch briefly upon the question of toll-line service. It has been asserted that there is no apparatus on the market which can be successfully used in long-distance work. This statement is incorrect. The Standard Telephone & Electric company has sold at various times to a toll-line company in the West telephones for long-distance service. The aggregate sales to date probably are not less than 2,000 instruments. This company controls and operates over 2,000 miles of toll lines, and is frequently called upon to communicate with parties separated many hundreds of miles. It is giving good service, and the apparatus is entirely satisfactory. The Standard company has also sold to parties who are operating as many as 20 instruments on lines varying from 50 to 250 miles in length. Needless to say that in some instances failures occurred until wires of lower resistance were used. Some of the beginners in long-line work have attempted to successfully talk over a 14 steel wire with 10 to 15 instruments connected in series; others have undertaken to establish a successful talking line over a conductor of similar size, bridging to earth; not a few have run metallic circuit wires failing to transpose. All this has been in the nature of experience to the investors, but, in spite of the money lost in gaining this experience, we find only a most favorable condition of affairs at the present writing. I refer not only to the quality of service furnished, but the earning capacity of a line or exchange plant, as the case may be. That a few of the exchanges installed a year and a half or so ago will need some overhauling due to inferior construction at the time of installation, is also a fact, but this does not imply any vast outlay. An exchange of 100 telephones can earn $100 per month after paying operators, rent and incidental expenses; such an exchange should not cost to exceed $4,000. With rates at an average of $2, for 100 telephones a revenue of $200 per month would be realized, of which $100 is sufficient for all expenses incurred, leaving a net of $1,200 per year on an investment of $4,000. Suppose that it is necessary to spend $50 per month of this sum in repairs and reconstruction, it still leaves $600 a year or 15 per cent. on an investment of $4,000; one could even stand a complete loss of plant once in every four or five years, and still make money in the telephone business at half the rates usually charged by the Bell Telephone company or its associate exchanges.

As an additional proof of the success of competitive telephone interests, it is only necessary to note the number of telephones now in operation and sold by the different manufacturers:

Company No. 1 claims to have sold			60,000 telephones
" " 2	"	"	50,000 "
" " 3	"	"	40,000 "
" " 4–8	"	"	50,000 "
Miscellaneous			25,000 "

Making a grand total of 225,000. Does this look like

failure, more particularly when we compare the figures with the Bell company's output for any three years of its experience and its present methods of discouraging competition? J. J. NATE.

Madison, May 1, 1897.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 1.—On Thursday the Rapid Transit Commission held a short meeting to talk over the work of obtaining consents of property owners in the various streets through which the rapid transit road is to run. Lewis L. Delafield, secretary of the board, said in reply to an inquiry: "If the consent of the majority in value of the property owners upon each street through which the railroad is to run is obtained, this board will be in a position to proceed immediately to frame a contract for the construction and operation of the railroad, and to advertise for bids for such contract. If the consent of the property owners upon any street is withheld, it will be necessary to seek the substituted consent of the Appellate Division of the Supreme Court. The obtaining of the latter consent might occupy a good deal of time." "Is there any prospect that ground for the railroad will be broken this year?" Mr. Delafield was asked. "Decidedly yes," he replied, "but, speaking for myself, I am of the opinion that if the Greater New York measure is approved by the governor it will very seriously affect the prospect of obtaining any adequate system of rapid transit unless the contract for the construction of the railroad is actually made before the proposed consolidation takes effect. My reason for saying this is that the narrowed debt-incurring capacity which would be occasioned by consolidation would not affect the right of the present city of New York to meet obligations lawfully undertaken before consolidation took effect."

Eugene Clifford Potter applied to Justice Beach, in the Supreme Court, on Wednesday, to continue, pending the determination of a suit brought by him, the temporary injunction restraining General C. H. T. Collis, commissioner of public works, from issuing a permit allowing the Metropolitan Street Railway company to tear up Sixth and Eighth avenue pavements, in order to substitute the underground trolley system for animal power, and also sought to restrain the traction company from changing the motive power of the two surface roads. Elihu Root and James C. Carter appeared for the defendant company, and submitted affidavits from business men in Sixth and Eighth avenues in favor of the change to electricity. Justice Beach reserved decision.

One of the features of the Grant monument celebration was the searchlight display in the evening. The scene on the Hudson near the tomb was beautiful. Beginning at the foot of the bluff and ranging far to the southward were hundreds of brilliantly illuminated vessels, the white hulls of the American warships sharply outlined against the opposite shore. From far down the river came the beams of the searchlights of the men-of-war sweeping the shores on either side, and now and then resting for brief intervals full on the tomb.

M. S.

PERSONAL

Morgan Brooks president of the Electrical Engineering company of Minneapolis, was in Chicago last week.

J. R. Cravath, formerly electrical editor of the *Street Railway Review*, Chicago, has severed his connection with that journal, and will devote himself to the introduction of a new device to be applied to electric motor cars for recording the power wasted by the motormen.

Herbert H. Brooks, the general manager of the American Circular Loom company, was in Chicago last week. Mr. Brooks is well acquainted with the electrical trade of Chicago, having been associated with Mr. Chandler in the establisment of the office of his company in this city. He was heartily welcomed by a host of friends.

Dr. F. W. Gunsaulus, the president of the Armour Institute of Technology of Chicago, who is also pastor of Plymouth Church, is considering the advisability of removing to New York to assume pastoral control of the Broadway Tabernacle. He is reported as saying that he is unwilling to leave Chicago, but that the proposition from the New York church is very alluring.

The Cia. Proveedora de Material Electrico of Mexico issues this statement: "We regret to announce the death by typhus on March 31st of T. C. Price, late manager of the Electrical Supply company of the City of Mexico. Mr. Price, although a comparatively new man in the field, had already won a host of friends here as well as in 'God's country' in the electrical field, and we are in receipt of many letters expressive of the esteem in which he was held. His position as manager of this company has been filled by the appointment of Joseph Ketchum of New York. Mr. Ketchum has been in the market as an engineer, manufacturer and dealer for the last 20 years, and we expect that the sound business methods practiced by Mr. Price in the conduct of the business will be ably continued by Mr. Ketchum."

An unusual number of out-of-town visitors registered at the headquarters of the National Electric Light association, New York, last week, including J. H. Bowker, Philadelphia; James Clark, Plainfield, N. J.; Wilson Kistler, Lockhaven, Pa.; J. H. Fredericks, Lockhaven, Pa.; O. W. Ruggles, Chicago, Ill.; L. A. Robinson, Pittsburg, Pa.; A. J. Smith, Cleveland, O.; B. F. Horner, Cleveland, O.; F. J. Moore, Buffalo, N. Y.; Frank Van Dusen, Pittsburg, Pa.; H. J. Caukins, Detroit, Mich., George W. Vallee, Philadelphia, Pa.; J. R. Wood, Philadelphia, Pa.; W. E. Davis, Montreal, Canada; D. B. Martin, Baltimore, Md.; Charles Schryver, Baltimore, Md.; C. E. Lambert, Haverstraw, N. Y., J. W. Packard, Warren, O.; W. H. Dearborn, Philadelphia, Pa; C. F. Munder, Springfield, Mass.; James I. Ayer, Boston, Mass; A. M. Young, Waterbury, Conn., and J. H. Reid, Pittsburg, Pa.

ELECTRIC LIGHTING.

Enterprising English lamp makers call attention to the fact that there is only a short time to prepare for the national illumination of June 22d, on the occasion of the queen's diamond jubilee, and suggest that electrical contractors prepare at once for the great demand for electrical signs and decorations.

MISCELLANEOUS.

More than 50 per cent. of the copper produced thus far this year in the United States has been exported. The supply for home use is, accordingly, restricted. Bids of 11½ cents for lake copper have been repeatedly refused, it is said, and 11¾ cents appears to be the bottom price. The European demand for the first two months of the year was largely in excess of the corresponding period in 1896. The increase in consumption in England, France and Germany for the two months is estimated at 8,354 tons. The outlook in the copper market is considered favorable.

According to *Glückauf*, the largest pumps driven electrically that have yet been constructed in Europe are being erected at the Kübeck shaft, Anina, Hungary. The plant consists of two three-ram pumps, each of which is designed to raise 176 gallons of water per minute to a height of 787 feet, driven by two motors, each of 60 horse power, making 550 revolutions per minute. At the mines of the Upper Hungarian Mining & Iron Works company, Szomolnokbuta, an electrically driven duplex pump is being erected for raising 154 gallons per minute to a height of 328 feet. Special interest is attached to this plant because of the metallic composition of which the rams and suction pipes are cast, and the fact that the cast-iron delivery pipes are lined with asphalt on account of the very acid water.

TRADE NEWS.

The Electric Appliance company is putting on the market a line of electric tailoring and laundry irons for which great claims are made. It goes without saying that the best work can be accomplished with an iron which can be kept constantly at a uniform temperature, and this can only be accomplished with an electric iron. The Electric Appliance company is prepared to send a special circular of this line of goods on application.

The business of Nightingale, Johnson & Co., electrical engineers and contractors, 26 and 28 Catharine street, Utica, N. Y., will hereafter be carried on under the firm name of Johnson & Morton, Mr. Nightingale retiring from the business. The old firm has met with gratifying success in contracting work and also in the manufacturing of special junction boxes and switchboards, and the new firm will carry on the same work, making every endeavor to give entire satisfaction to customers. New machinery has been placed in the shop, and the firm is now equipped to do a general electrical repairing business.

The Swarts Metal Refining company of Chicago has secured the building at No. 20 North Desplaines street, where its facilities for handling larger quantities of metal are greatly improved. A few years ago the company was hardly known to the metal trade. To-day, with customers in every state and territory in the Union and a good export trade, it is perhaps as widely known as any firm in the same line of business. The business was secured in a comparatively short space of time by fair treatment of customers, liberal advertising and by making fortunate purchases which made low quotations possible. An invitation to call at the new quarters is extended.

The Peerless Rubber Manufacturing company announces that discharged and ex-employes are making false claims as to the founding of this company and the manufacture of its goods. It adds that the company was founded in 1872 by Charles Foster, Jr., and Henry S. Winans, who associated with themselves as superintendent John H. Deming, who has had entire charge of the manufacturing department. Mr. Deming has been with the company continuously since 1872, and is at present general superintendent. He has had 34 years' continuous experience in the manufacture of fine mechanical rubber goods. Rainbow packing was suggested by a prominent merchant to C. H. Dale, then general sales agent, and with all other goods made by this company was introduced to the trade solely by Mr. Dale. Mr. Deming is the only man who has ever manufactured Rainbow packing, and the company claims that he is the only man who knows how.

"The Care of Commutators" and "A Few Points in Relation to the Construction of Commutators" are subjects of such general importance to all who have to deal with electrical apparatus that the little reprint of two papers on these subjects from the *American Machinist*, which has just been issued by Charles Wirt of Philadelphia, will prove valuable. Incidentally; Mr. Wirt takes occasion to call attention to the merits of the Wirt dynamo brush, which is just now having such a large sale. Wirt brushes are intended for all cases where a metal brush can be used, with the exception of open-coil arc dynamos. This excludes railway motors and all cases where end-on carbon brushes are used.

Recent additions of presses to the United Brethren publishing house in Dayton, Ohio, are notable by the direct attachment of slow-speed electric motors made by the Thresher Electric company of that city. A regulator is provided with each motor, giving four variations of speed, placing the press under immediate control of the operator, so that the speed can be varied according to the work in hand. The motor attached to the web press has a capacity of 20 horse power and operates at a speed of 180 to 280 revolutions per minute. It is provided with automatic attachments, so that in case the press has to be stopped on account of the paper breaking or from other causes, it is brought to a dead stop by pressing a push-button, which entirely cuts out the motor and applies an electric brake. Two 40 horse power dynamos furnish light and power for the establishment

The Cleveland Ship Building company has awarded to the Card Electric company of Mansfied, O., the contract for the entire electrical equipment of its new shipbuilding yards and establishment, which will be located at Lorain, Ohio. The electrical apparatus covered in this contract calls for one 100 kilowatt 240 volt direct-connected generator designed for a speed of 250 revolutions per minute, one 40 kilowatt 240 volt belted generator and 26 motors, varying in size from two up to 40 horse power. The motors are to be used in various departments of the works for driving machinery of different kinds. In this equipment of motors there will be two of 30 horse power capacity, to be used for operating two large bending rolls, etc., the total equipment aggregating 500 horse power. It is said that there are only two electrical manufacturers in the United States beside the Card company in position to furnish all of the apparatus called for in the specifications, owing to the design and sizes of the motors adapted for the special use of the Cleveland company.

Writing of the business outlook, President Ford of the People's Electric company of Madison, Wis., says: "We are having a very good trade, as the weather permits the commencement of construction work, and we think that this year will be a decided improvement over 1896. We have secured the contract for material for the plant which is being put in at Randolph, Wis., and have several more plants for which we are ready to close contracts. Our shipping facilities are considerably improved over those of last year, owing to some changes in the running time of trains running out of Madison, and, as you know, there are about 20 trains a day on the Chicago & Northwestern railroad, Chicago, Milwaukee & St. Paul and Illinois Central, which enable us to reach our trade with very little delay. We have been especially fortunate in securing many desirable things to handle during the coming year, and these, with our old stand-bys such as Wagner transformers, the New York Insulated Wire company's wires and Anchor and Paiste goods, give us an assortment to offer to our friends and customers which we think will be winners. We are at present devoting all our energy to getting out our new catalogue, which we hope to have ready by the 1st of June, if not before. In the meantime we are in a position to quote the very best of prices on the very best goods to all who may ask for them. Under its new management our company hopes to meet all its old friends, and has already made many new ones. Its motto of 'A square deal or no deal' will be carried out in spirit as well as in letter, as it is our belief that only through this method of doing business can success be obtained."

BUSINESS.

The American Battery company, Chicago, reports a carload shipment to Mexico of 122 boxes containing 88 storage cells.

The firm of Carlisle & Finch, manufacturers of searchlights, has been succeeded by the Carlisle & Finch company, with a capital stock of $10,000. The address of the company is 828-830 West Sixth street, Cincinnati.

The Missouri Telephone Manufacturing company is now putting on the market an entirely new invention in the way of a switchboard drop, Mr. Lewis of that concern being the inventor. This drop has been put to all manner of tests and has proved itself very efficient.

James S. Barron & Co of New York, wholesale dealers in general electrical supplies, announce their removal to their new building at the corner of Hudson and Duane streets. The offices of the electrical department are located on the second floor, where Manager Copeland will be pleased to meet any of the friends of the firm.

One of the important trade catalogues for 1897 is that of Charles H. Besly & Co., 10 and 12 North Canal street, Chicago. The book is in a convenient form for desk, pocket or tool chest (size 4½ inches by 8½ inches), and contains 300 pages of matter relating to manufacturers

and machinists' hardware, brass and copper in rolls, sheets, rods, tubes and wire, fine tools for metal workers, seamless tubes in brass and copper, platers, polishers and grinders' supplies, and supplies for machinists, railroad shops, founders, molders, agricultural implement manufacturers, pump manufacturers, gold, silver, and nickel platers, amateurs, grinders, polishers, inventors, pattern makers, gunsmiths, locksmiths, blacksmiths, bicycle manufacturers, electrical, iron and steel manufacturers, saw-mill men, etc. The arrangement of this work is excellent, and many half-tone illustrations serve to elucidate the text. Full descriptions have been embodied as far as possible and the cuts and subject matter are so condensed that Besly & Co. are able to present in the scope of their book as much matter, perhaps, as is ordinarily shown in a book of 1,000 pages. Manufacturers' lists are used exclusively. Special attention is called to the index or finding-list, which contains over 1,700 titles. The firm of Charles H. Besly & Co. was established in 1876. Its endeavor has been to be ever in advance of the demands of the trade and by courteous treatment and honest dealings merit patronage. The catalogue will be sent to any address upon application.

Thomas Smith & Co. of Worcester, Mass., report a steady growth in the business of supplying armature disks. Three years ago this house began business in this line, supplying a few customers in New England, but the demand has steadily increased, and now large quantities of disks are shipped to all parts of the country. The uniform excellence of the product is said to account for this.

The Card Electric company of Mansfield, Ohio, has recently booked the following orders: One 30 kilowatt direct-connected generator to Thos. McGraw, to be installed in McGraw building, Detroit, Mich.; one 50 kilowatt direct connected generator, Mechanical Rubber company, Cleveland, Ohio; two 10 horse power motors with automatic controller for operating elevators, to the Edmonds Elevator company, Cleveland, Ohio; one 100 kilowatt direct-connected generator to the Ohio & Pennsylvania Coal company, Salineville, Ohio; one 10 horse power motor to M. A. Bradley, Cleveland, Ohio; two 10 horse power motors to Wolverine Manufacturing company, Detroit, Mich.; one 100 kilowatt belt-driven generator to Monongah Coal & Coke company, Monongah, W. Va.; one 65 kilowatt belt-driven generator to Jeffrey Manufacturing company, Columbus, Ohio; three 25 horse power motors to H. J. Heinz company, Allegheny, Pa.; one 11 kilowatt belt-driven generator to Union City Ice company, Union City, Tenn.; one 50 kilowatt belt-driven generator and switchboard to Wm. Metcalf, Pittsburg, Pa.; one 20 horse power motor to Mansfield *News;* one 25 kilowatt belt-driven generator to Oak Ridge Hotel, Green Springs, Ohio; one 10 horse power motor to Stewart, Howe & May, Cleveland, Ohio; two 100 kilowatt belt-driven generators, one 67 horse power and two 30 horse power motors to the Raton Coal & Coke company, Raton, N. M.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued April 27, 1897.

581,263. Electrical Connection. Harold P. Brown, New York, N. Y. Application filed February 2, 1895.

The combination with two meeting or jointed conductors, of a permanently plastic alloy electrically connecting the two.

581,281. Underground Trolley Conduit. John D. Griffen, New York, N. Y. Application filed May 22, 1893.

An underground trolley conduit, comprising a main trench formed of metal yokes set at intervals apart in the ground, the intermediate space being closed to form a continuous main trench, slot-rails mounted on the yokes and a diaphragm forming a trolley casing closed at its bottom and sides and fastened in and along the main trench, the trolley casing having an opening or slot at its top near one side of the main trench, and a separate guard-plate secured to the structure above the trolley casing, the adjacent edges of the guard-plate and the diaphragm of the trolley casing being in substantially the same horizontal plane and offset or spaced therefrom to form a second or interior slot, in combination with a trolley arm bent to form an angle below the guard-plate, and also bent to form another angle above the upper edge of the trolley casing.

581,283. Secondary Battery. Varian M. Harris, Chicago, Ill. Application filed July 6, 1896.

A central metallic positive element is surrounded by a porous cup containing a mass of active material; there are also an outer copper gauze mercury-covered negative element, a case or cup to contain the whole, and a suitable fluid within the same.

581,298 Registering Mechanism. William H. McFall, Philadelphia, Pa. Application filed February 6, 1897.

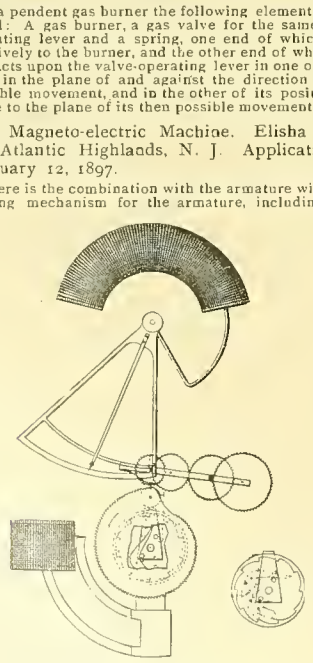
When used in an electric meter there is the combination with an ampere indicator, of a register or counter, an actuator in the form of a cam engaging the gearing of the counter, a motor for rotating the cam, and means controlled by the ampere indicator for varying the engagement between the cam and gearing.

581,327. Electric Gas Lighter. Lewis L. Borradaile, Philadelphia, Pa. Application filed December 23, 1896.

In a pendent gas burner the following elements are combined: A gas burner, a gas valve for the same, a valve-operating lever and a spring, one end of which is fixed relatively to the burner, and the other end of which is free and acts upon the valve-operating lever in one of its positions in the plane of and against the direction of its then possible movement, and in the other of its positions at an angle to the plane of its then possible movement.

581,340. Magneto-electric Machine. Elisha B. Cutten, Atlantic Highlands, N. J. Application filed February 12, 1897.

There is the combination with the armature winding and driving mechanism for the armature, including as part



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thereof a gear-wheel, of a spring-contact device adapted to engage the teeth of the gear-wheel during rotation thereof, a shunt circuit for the armature including the wheel and spring-contact device, and means, such as a lever, for moving the spring-contact out of position for engagement with the gear-wheel.

581,350. Telephone Instrument. James E. Keelyn, Chicago, Ill. Application filed January 5, 1897.

Claim is made for a magnet carrying a coil at one end, a disk screw-threaded on its outer surface rigidly mounted on the magnet, and an outer shell carrying a diaphragm and having on its inner surface a screw-thread into which the threaded disk fits, whereby the magnet may be adjusted longitudinally toward or from the diaphragm by turning it in the shell, and means whereby the magnet may be clamped into any desired position.

581,366. Electric Generator. Charles C. Poole, Evanston, Ill. Application filed February 26, 1894.

An electric generator, consisting of a plurality of generator sections having reciprocating moving parts, and which act successively in the production of current, each of the generator sections embracing a plurality of conductors or generator elements acting to produce a plurality of electric inductions or impulses during the middle part only of the stroke of the movable part in each direction.

581,368. Support for Electric Railway Conductors. Edward D. Priest, Schenectady, N. Y. Application filed August 28, 1896.

The support consists of a clamp having separable members adapted to engage with the inner surface of the conductor, and means for separating the members of the clamp after they are placed in position.

581,406. Telephone Receiver. William J. Morton, New York, N. Y. Application filed May 15, 1895.

A telephone receiver having a soft-iron diaphragm located between two magnets, one of the magnets being a permanently magnetized disk and provided with perforations.

581,411. Printing Telegraph. John Burry, Long Island City, N. Y. Application filed June 27, 1896.

The combination is claimed of opposite magnets, an armature between them, stops carried by the armature, and adjustable magnet spools provided with beveled heads for coaction with the stops.

581,426. Primary Battery. Richard R. Moffatt, Brooklyn, N. Y. Application filed September 1, 1896.

A battery is described, comprising a metal frame having a plurality of openings and a plurality of independent battery vessels, each consisting of two cups having rims secured in the openings of the frame.

581,430. Semaphoric Electric Signal. Robert S. Roberts, Philadelphia, Pa. Application filed October 16, 1896.

An electro-magnet is adjustably borne by the frame, the helices of the magnet having proper terminals adapted to receive the ends of an electric circuit; a rocking shaft is adjustably journaled in the frame, with an armature adjustably attached to the rocking shaft and operatively presented to the poles of the magnet; semaphoric arms are attached to the rocking shaft; adjustable means are provided for limiting the oscillation of the arms, whereby one arm alone is visible through the sectoral opening when the magnet is energized, and another arm alone visible through the sectoral opening when the magnet is demagnetized.

581,446. Electric Call. Hubbard C. West, New York, N. Y. Application filed July 29, 1896.

The principal claim is given: An electric call, comprising two batteries located at two stations, one at each station, a call-bell at each station, a switch at each station, each switch having three contacts, the middle contact being connected to line, and the end contacts being joined by a conductor including the call of the station, and each switch also having two contacts movable relatively to said three contacts and connected by a conductor including the battery, said latter contacts adapted to close with one end and the middle contact, or with the other end and the middle contact of the three contacts first mentioned, and the normally open end contact of said three contacts being connected to line, whereby the call-receiving circuit at each station includes the call thereof, and the call-transmitting circuit of each station excludes said call.

581,460. Electric Fuse. Walter E. Harrington, Philadelphia, Pa. Application filed October 29, 1895.

An electric fuse having a central primary section, terminal sections of greater cross-section, and masses of non-conducting material arranged to surround portions of each of the terminal sections without inclosing the central primary section.

581,465. Revolving Electric Headlight. John Kirby, Jr., Dayton, Ohio. Application filed February 2, 1897.

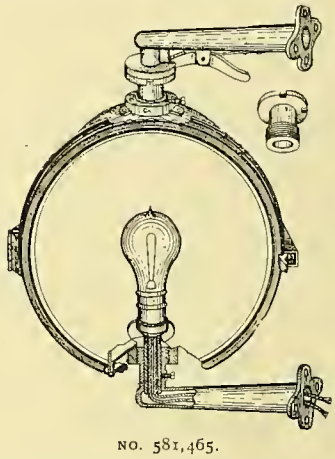
In a revolving headlight there is the combination of a screw-threaded bearing at one side thereof, and a corresponding screw-threaded journal fixed to a suitable support, and on which the bearing revolves; a non-screw-threaded bearing and a corresponding journal on which the same revolves at the opposite side thereof, the latter journal being likewise fixed to a suitable support, and means for controlling the movement of the headlight and securing it in either of several positions on the journals.

581,528. Electrical Alarm Device. John J. Barton, Ypsilanti, Mich. Application filed December 12, 1896.

The claim is made for the combination of two magnets, a single armature for the magnets, a bell, a knocker for the bell carried by the armature, a normally open circuit, including a battery and one of the magnets, the armature and a contact point to be engaged by the armature when the magnet is not excited, a normally closed circuit including the other magnet, a battery and two plates, and a plug arranged to be inserted between the plates, and when so arranged to cut the magnet out of the normally closed circuit.

581,544. Thermostatic Fire Alarm. Oscar A. Eoholm and Thomas H. Beck, New York, N. Y. Application filed November 23, 1896.

In an electric thermostatic alarm there is the combination with the circuit, of a rotatable recessed disk contain-



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ing fusible material, and a spring, one end of which rests on the surface of the wax, the disk and the spring being connected with the terminals of the circuit.

581,557. Controller for Electric Cars. Slaughter W. Huff, Baltimore, Md. Application filed July 26, 1895.

In a controller for electric cars the combination is claimed of the fixed and movable parts, the hollow thimble on the fixed part forming a conduit for wires, and means of attachment and the adjustable collar.

581,561. Selective Signal for Telephone Circuits. Henry W. Mason, New Bedford, Mass. Application filed July 31, 1896.

A vertical switchboard is provided with a series of inclined parallel ways, having their upper ends provided with switch-points, and their upper sides with contact-pieces, one of which constitutes one terminal of a bell circuit; a circuit closer is adapted to be switched by the switch-points to traverse either of the contact-pieces; a circuit closer carrier is adapted to be raised vertically over the inclined ways, and, when released, to resume its normal position by gravity, and means provided whereby the carrier is raised to any desired point on the switchboard and released.

581,658. Electric Motor Controller. William H. Chapman, Portland, Me. Application filed February 24, 1896.

In combination with an electric motor having a shunt winding on its field, a coil of wire is connected in series with the shunt winding and having a vertically movable iron core, a series of conducting segments arranged in the arc of a circle and forming the terminals of a set of resistance coils, a contact-shoe operatively connected to the upper end of the core and arranged to move in tangential contact with the peripheral surface of the series of segments, a piston and cylinder operatively connected to the lower end of the core, a ring placed loosely on the top of the piston and made to fit the cylinder more closely than the piston, adapting it to operate as a valve and to check the upward movement of the core more than it does the downward movement.

581,684. Electrical Transmission of Power. Rudolph M. Hunter, Philadelphia, Pa. Application filed November 9, 1887.

Two or more secondary generators are arranged close to the primary generator, a local circuit connecting the coarse-wire coils of the secondary generators in parallel with the primary generator, a line circuit including the fine-wire coils of the secondary generators in series, a tertiary generator having its fine-wire coil connected with the line, and a distant local circuit containing current-consuming or translating devices receiving current from the coarse-wire coil of the tertiary generator and permanently closed when operating.

Western Electrician.

EVERY SATURDAY.

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Three-phase Transmission Plant at Traverse City, Mich.

An interesting three-phase transmission plant has been in successful operation for some time at Traverse City, Mich., putting to practical use the hitherto unutilized waters of the Boardman River.

The project of harnessing the river and utilizing its energy was set afoot late in 1893, and 200 acres of land on both sides of the river, 4½ miles from Traverse City, was purchased. It was not until almost the end of the year, however, that the adoption of electricity was determined upon and the Boardman River Electric Light & Power company organized. In April, 1894, work was begun on the dam, and on June 15th, last year, the waters of the Boardman River were turned from the course they had followed from time immemorial. The dam is 700 feet long, 175 feet wide at its base and 30 feet wide at the crest. The height of the dam is 24 feet, and the depth of water about 22 feet. Over 1,000,000 feet of timber was used, including 300 cedar piles, and 300 cords of stone was laid as foundation. The chute is 210 feet long and 30 feet wide, and it is estimated that 30,000 cubic feet of water per minute will always be available.

A canal leading to the power house has been excavated. It is 250 feet long, 50 feet wide and 12 feet deep. The plant is operated under a head of 15 feet, 300 horse power being taken. The ultimate capacity will be about 1,200 horse power.

The power plant is located on a site apparently devised by nature for advantageous development, as will be readily understood from examination of the illustration (Fig. 2) on page 270. The river banks are so shaped and situated that by raising a comparatively short dam the whole stream could be deflected if necessary into the canal, forming at the same time a small but deep pond of ample capacity and depth enough to prevent the formation of the much dreaded anchor ice.

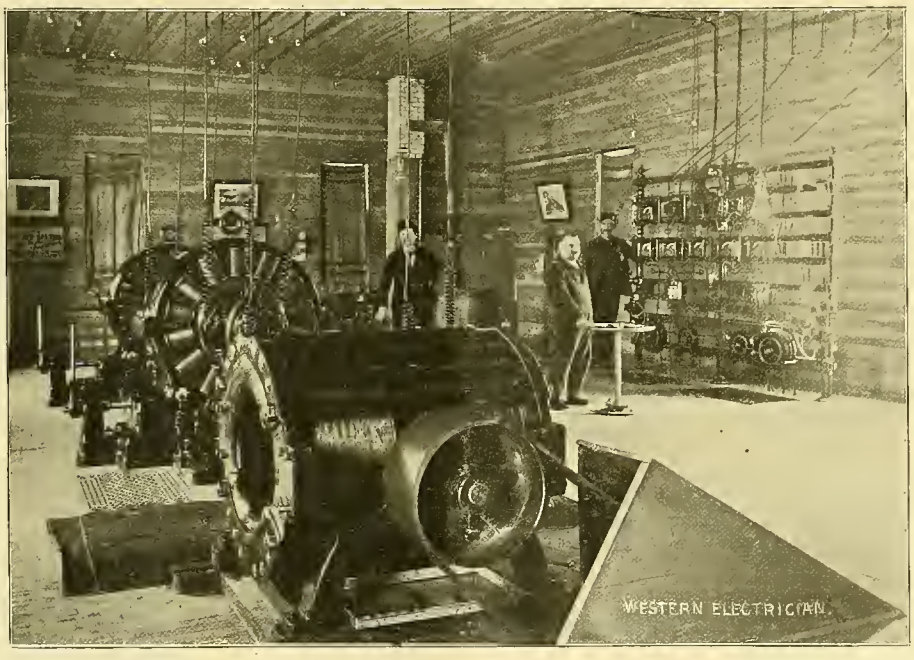

FIG. 1. THREE-PHASE TRANSMISSION PLANT AT TRAVERSE CITY, MICH.

The power house stands at the head of the short canal. It is a frame structure, sheathed within and covered without with corrugated iron. The lower floor is occupied as the wheel room, containing a 48-inch Samson cylinder turbine, from the James Leffel & Co. works, belted to a jack-shaft, from which belts pass to the dynamos on the floor above. The dynamo room (Fig. 1) is on the level of the canal bank and contains two 60 kilowatt General Electric three-phase generators, with the appropriate station equipment. A Thomson-Houston arc machine is also installed. The equipment is in duplicate, and renders possible a continuous 24-hour service without fear of annoyance from accident or failure.

From the power house the current at 2,500 volts is carried to Traverse City over three No. 1 copper wires, stretched over 30-foot cedar poles, to step-down transformers filled with oil, reducing the pressure to 115 volts. Branch wires are stretched all over the city, and the electricity is brought to the door of almost every inhabitant. Alternating arc lamps, incandescent lamps and induction motors are all operated from these lines, with the same satisfactory results as are found in every other three-phase installation undertaken by the General Electric company. A telephone line connects the station with the offices in Traverse City. The officers of the company are: President, Frank Friedrich; vice-president, E. Greilick; secretary, A. V. Friedrich; treasurer and general electrical superintendent, William Bauer.

Alley "L" Electrical Equipment.

Bids are in for the power house machinery and feeder cables for the new electrical equipment of the South Side Elevated Railroad company of Chicago, but no contracts have been awarded.

In the matter of car equipments it is understood that Frank J. Sprague is to secure the contract, and that he will install a new system by which every car will be propelled by its own motors. Mr. Sprague is a pioneer in the electric railway field, but has of late years turned his attention to elevator work. His plan contemplates 120 car equipments. Each equipment will consist of two 55 horse power motors installed on one truck, complete with a controller outfit and contact shoes. Thus every car can be operated independently if desired, approximating street-car practice and improving the service by decreasing the time interval between trains during the hours of light traffic. However, during the "rush" hours several cars will undoubtedly be coupled together as at present. By Mr. Sprague's method of motor control these can all be operated by one motorman in the forward car. The system includes the use of small pilot motors to operate the controller levers on the individual cars. These motors can be controlled from any point on the train by a circuit of light wire and a three-way switch. The only electrical connection between the cars will be the light pilot-motor circuit, and thus trains of any number of cars can be made up without the use of electric locomotives and with but one motorman to a train. The system gives great flexibility in train operation and promises a decided improvement in elevated railway work. Mr. Sprague will sub-let contracts for the motors and trucks, the railroad company supplying its present car bodies for equipment.

American Street Railway Association.

Circulars have been sent to members of the American Street Railway association and others who might desire to attend the sixteenth annual meeting of the organization, which will be held at Niagara Falls, announcing the preparations that have been made for the meeting and explaining the requirements of the passenger associations in the matter of securing reduction of fare under the certificate plan. The convention will assemble on October 19th and last four days. It is proposed to hold the meetings and the exhibition of street railway apparatus in the same building—a temporary structure now being built for gatherings of this character. The meetings will be held on the second floor of the building, which will be arranged especially for this purpose. The lower floor will be devoted to exhibition purposes. The building will be 120 feet by 154 feet and will have plenty of light. Power will be furnished to exhibitors and the building will be comfortably heated. The headquarters of the association will be established at the International hotel, Niagara Falls, during the convention. The annual dinner will be held at the International Hotel on October 21st at 8 P. M. The building in which the meetings and the exhibition will be held within easy access of the principal hotels.

The programme for the meetings is now being arranged. The list of subjects upon which papers will be read has already been decided upon and includes the following:

Municipal Ownership of Street Railways.

Modern Electric Railways: Their Construction, Operation and Disadvantages.

Application of Electricity to Railroads Now Operated by Steam Power.

The Best Method of Settling Damage Cases and the Prevention of Accidents by the Use of Fenders and Otherwise.

Producer Gas for Use in Street Railway Power Houses and Gas Engines.

Storage Batteries for Street Railways.

Discipline of Employes.

Long-distance Transmission and the Use of Multiphase Current for Ordinary Street Railways.

New Canadian Tariff.

The following are the rates of duty under the new Canadian tariff on items that are of interest to the electrical industry:

Wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered, not elsewhere specified, 25 per centum ad valorem.

Wire of all metals and kinds, not otherwise provided for, 20 per centum ad valorem.

Wire rope, stranded or twisted wire and wire cable, not elsewhere specified, 25 per centum ad valorem.

Wire, cloth or woven wire, or netting of iron, steel, brass, copper or other material, 30 per centum ad valorem.

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds, and electric apparatus, not elsewhere specified, 25 per centum ad valorem.

Electric light carbons and carbon points of all kinds, not elsewhere specified, 35 per centum ad valorem.

Carbons over six inches in circumference, 15 per centum ad valorem.

Lamps, sidelights and headlights, lanterns, chandeliers, gas, coal, or other oil fixtures and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade-holders, 30 per centum ad valorem.

Lamp springs and glass bulbs for electric lights, 10 per centum ad valorem.

L. B. Engle of Nelsonville, Athens county, Ohio, was granted a franchise May 1st to establish a telephone exchange in Logan, Ohio.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part V.

Engines.

Having considered the devices used to transfer the greatest possible number of heat units from the fuel to the steam, we are now ready to discuss the steam engine, the device by means of which the energy of the steam is turned into mechanical energy ready to give motion to the electrical generator. Here we find ourselves confronted with a great variety of types and styles, all agreeing in general principle but differing in details in a way calculated to confuse the novice.

In the time at our disposal it is impracticable to attempt to discuss the theory of the steam engine to any greater extent than was embodied in Lectures I. and II.

FIG. 2. THREE-PHASE TRANSMISSION PLANT AT TRAVERSE CITY, MICH.

Our object at the present time will be to call attention, briefly, to the general conditions for economy in the engine when working under different kinds of loads; to endeavor to classify the different types and discuss their advantages; to show the steam economy to be expected of the different classes; to point out the considerations external to the engine itself which enter into its selection, and, finally, to mention some of the things a designer of power plants should know about the main parts, relating to strength, proportion and relationship, in order that he may intelligently select an engine for the work in hand.

The conditions for the best working efficiency of the engine are, briefly:

First—High steam pressure. The influence of steam pressure upon the engine efficiency was discussed in Lectures I. and II., where the effect of increased steam pressures, and, consequently, higher temperatures upon the theoretical law for the efficiency of the engine, as derived from the second law of thermo-dynamics, was pointed out. Recent engineering practice tends constantly toward higher steam pressures where economy of fuel is an important item. At the present time, how ever, 200 pounds seems to be the limit which may be considered safe with existing methods of construction.

Second—Low exhaust pressure. The lowest exhaust pressure can be obtained by the use of a condenser which will reduce the pressure from 15 pounds per square inch (that of the atmosphere), against which a non-condensing engine exhausts, to from two to five pounds. When a condenser is used the engine is known as a "condensing" engine. Condensation has practically the same effect as increasing the steam pressure about 10 pounds, and since this additional pressure or, rather, this greater difference between initial and exhaust pressures, is secured without increasing the boiler pressure, the added efficiency due to condensing is apparent. The increase in power which may be obtained by using a condenser having a vacuum equivalent to V pounds mean effective pressure per square inch of piston area may be obtained from the formula

$$\text{Horse power gained} = \frac{V A S}{33{,}000},$$

Where V = Vacuum in pounds per square inch.
A = Area of piston in square inches.
S = Piston speed in feet per minute.

Deducting the power required to work the condenser, the practical gain of a condensing engine over a non-condensing type is, in general, from 20 to 30 per cent., and it is customary to calculate on about 25 per cent. for average conditions. The types of condensers have already been discussed in Lecture IV.

Third—Small cylinder condensation. Any attempt to fulfill the first two conditions of economy by securing the greatest possible difference in the pressure and temperature of the steam entering and exhausted from the engine cylinder will be confronted by the fact that when steam at a high pressure is worked at a great rate of expansion the extreme variations in temperature of the cylinder during each successive stroke cause condensation, followed by evaporation. These processes result in loss of heat and a consequent reduction of the expected economy. A common method used to overcome the losses due to cylinder condensation is to expand the steam in two or more cylinders successively, instead of in one, thus reducing the range of temperature in each. Engines are known as "simple," "compound," "triple" or "quadruple," depending on whether the steam passes through one, two, three or four cylinders. The greater the number of expansions the less the loss due to cylinder condensation and consequently the higher the steam pressure possible. On steady loads the steam economy is always, of course, the greatest with the quadruple expansion engine.[1]

Fourth—Heat losses due to radiation and conduction should be checked as far as possible. This dictates the use of suitable non-conducting jackets for the cylinder and steam chest. With large sized engines it is found to be economical to provide steam jackets by means of which the cylinder is surrounded by live steam.

Fifth—The admission valves should admit steam into the cylinder promptly at full boiler pressure, and after sufficient steam has been admitted the valves should close quickly. These results are accomplished the most effectually by the releasing valve type of engines, which will be referred to later. The exhaust valves should open promptly to allow the steam to escape and close just at the right time to allow the piston to properly compress the remaining steam and form a cushion for overcoming the inertia of the piston and other moving parts at the end of the stroke.

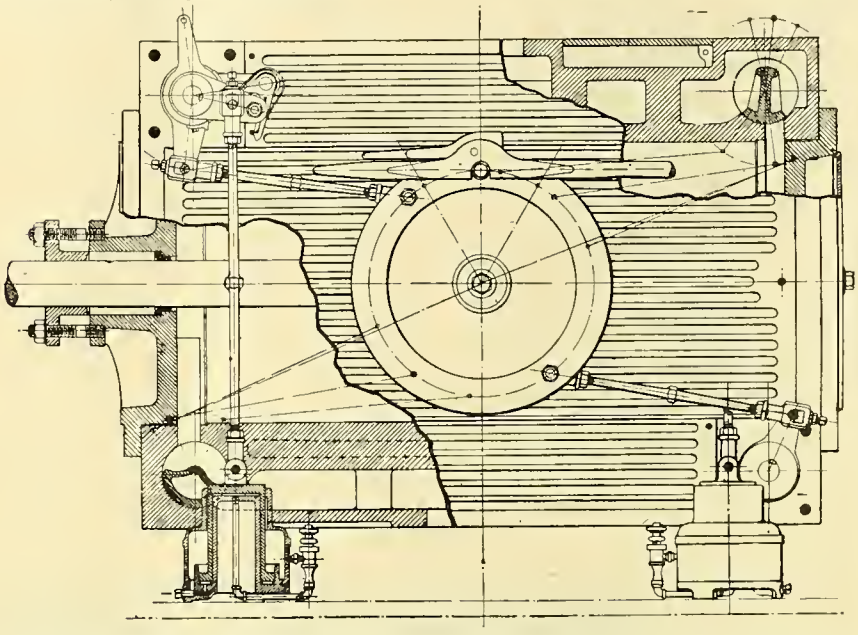

FIG. 11 DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL CORLISS CYLINDER.

Valve Types.—Valves may be classed under two general heads, the classification depending on whether the admission and exhaust valves are independent or not. With the independent type four valves are usually provided, two for admission and two for exhaust. The cylinder shown in Fig. 11 is fitted with a Corliss valve gear, which is one of the best types of the independent valve. The valves operate by turning slightly and can be thrown wide open or closed very quickly. The great advantage of the independent valves is that the admission of the steam can be controlled irrespective of the position of the exhaust valves.

In the Corliss type all four valves are driven from a "wrist-plate" which is pivoted on a pin projecting from the center of the cylinder and is operated by an eccentric attached to the main shaft of the engine. The actual closing of the admission valves, however, is effected by atmospheric pressure, by means of a vacuum pot, called a "dash-pot," which is very quick in its action. The point of closing of the valves is determined by the governor, which operates to change the length of the admission of the steam into the cylinder as the load upon the engine varies, by releasing the steam valves from the power which drives them and allowing the dash-pots to suddenly close them. In this manner the governor is relieved of all work of operating the valves and is only called upon to set, by means of light and easily operated parts, the small cams or projections which release the steam valves. The general arrangement of the Corliss mechanism is shown in Figs. 11 and 12, the latter being the highest type of Corliss cylinder. The valves in the latter are in the heads to reduce the port areas and the cylinder is steam jacketed to prevent radiation.

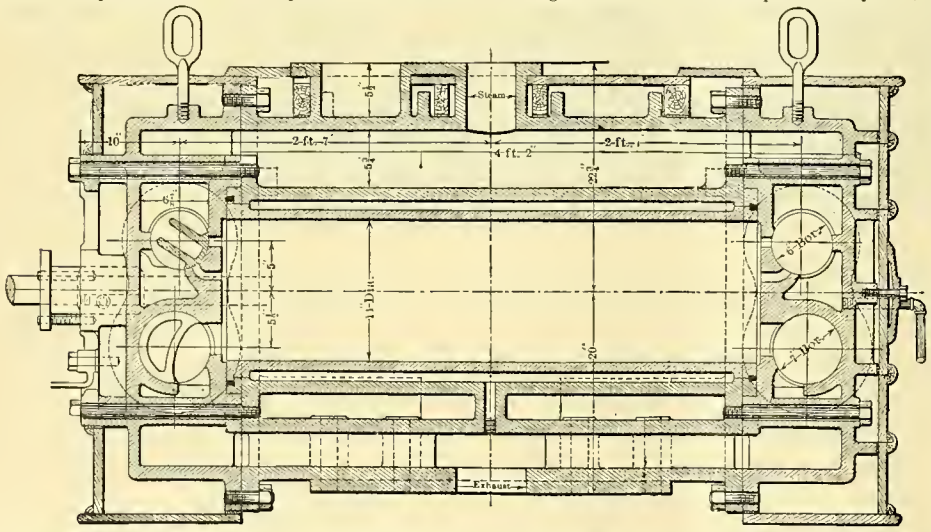

FIG. 12. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—CORLISS CYLINDER WITH VALVES PLACED IN HEADS TO REDUCE CLEARANCE.

Of valves in which the admission and exhaust are not independent there are two general types—slide valves and piston valves.

A typical balanced slide valve, such as is used in electric plants, is shown in Fig. 13 (p. 271). Slide valves have the advantage that, if properly made and fitted, wear will not cause leakage. Unless they are properly balanced, however, the steam pressure is upon one side only, which causes excessive friction between the valve and seat and reduces the efficiency of the engine.

A piston valve is shown in Fig. 14. This valve has the advantage that a large opening of the port can be obtained with a very small movement, and on account of being surrounded by steam it is easily balanced; but, on the other hand, the natural wear to which it is subjected soon causes leakage, and, unless the valves and seats are replaced by new ones when worn, the engine becomes very wasteful of steam. Again, as it is necessary to entirely surround the valve with the ports in order to get a large and quick port opening from a valve of small diameter, the volume of the ports is much greater than is required to accomplish the same result with a slide valve, resulting in an unnecessary amount of clearance, with the consequent waste of steam at each stroke of the piston. These objections have caused engine builders as a rule to abandon the use of the piston valve, which five years ago was so popular, and to adopt some form of the

1. Since these lectures were delivered there has been published in the *Engineering News* of April 8, 1897, a very complete description of a new method of utilizing the heat units of a steam plant, developed by the late A. M. Wellington, formerly editor of the *Engineering News*, in which he proposed to use a number of boilers, engine and condenser units of a given size in multiple. The hot gases from the furnace were to pass successively through the series of boilers, and the condensing water was to be passed in the opposite direction from that of the gases, through the condensers arranged in series. By this method he expected to utilize a larger proportion of the heat units of the furnace and effect a great saving. The plan has not yet been tried, but the discussion is very interesting.

slide valve on simple engines. If this type of valve is properly balanced and accurately fitted to its seats, it is very satisfactory in operation, but if not it becomes more wasteful than the piston valve. Slide valves are usually accurately fitted by the builder before the engine leaves the shops, but it sometimes happens that owing to the unequal expansion of the cylinders the valve seats become warped, or the valves themselves warp when hot, thus causing serious leaks. When this happens the valve and seat should be scraped hot until a suitable joint is made.

In compound engines the use of the piston valve for the high-pressure cylinder is not objectionable, for the reason that whatever steam is used or wasted by the high-pressure cylinder on account of the large steam ports or by leakage is used over again in the low-pressure cylinder. Fig. 15 shows a compound engine in which a piston valve is used on the high-pressure cylinder and a slide valve for the low-pressure cylinder. Almost all of our modern marine multiple expansion engines are fitted with piston valves on the high and intermediate cylinders, but with slide valves on the low-pressure cylinders. This arrangement allows the use of balanced valves for the cylinders working under high-pressure steam, but permits the reduction of the clearance to a minimum at the vital point, viz., where the steam leaves the last or low-pressure piston to enter the condensers. Fig. 16 shows a four-valve engine of the slide-valve type.

Point of Cut-off.—Stopping the admission of the steam to the cylinder at just the right point has been spoken of as one of the duties of the admission valve. This point is termed "the point of cut-off," and with all engines there is a point corresponding to each steam pressure and load which is the "most economical point of cut-off." If the steam is cut off before this point is reached the expansion is carried too far, and losses by condensation result; if the cut-off is prolonged until this point has been passed, then there is insufficient expansion, and a consequent waste of steam, owing to the exhaust taking place at too high a pressure. With most engines the "point of cut-off" is determined by the maker and stipulated when rating the engine. With a simple engine it will vary from one-fifth to one-quarter stroke, depending on the steam pressure, while in compound engines it is usually placed at five-sixteenths stroke, and sometimes as high as three-eighths stroke in the high-pressure cylinder, for the reason that the steam is utilized again in the low-pressure cylinder, as previously stated, and in order that the high-pressure cylinder may be made to do its proper portion of the work with a limited diameter of cylinder. Fig. 17 (p. 272) is an efficiency curve of a simple condensing engine operating under 100 pounds steam pressure, and will serve to show graphically the variation in the economy of an engine working under different loads, and that the point of cut-off for this particular type of engine for best economy is at $\frac{1}{4}\frac{1}{6}$ stroke.[1]

Speed of Engines.—There is yet one other classification of engines, into which they may be divided according to the number of revolutions per minute, viz., high speed, low speed and medium speed.

High-speed engines are generally used in small plants, and run at 200 to 350 revolutions per minute. Engines of this class usually have a governor of the centrifugal or inertia type, which is carried on the main shaft or in the flywheel.

Governors.—The action of all governors upon steam engines operating electrical generators is to keep the speed as nearly constant as possible, whether the engine is operating on "full load," "underload" or "overload."

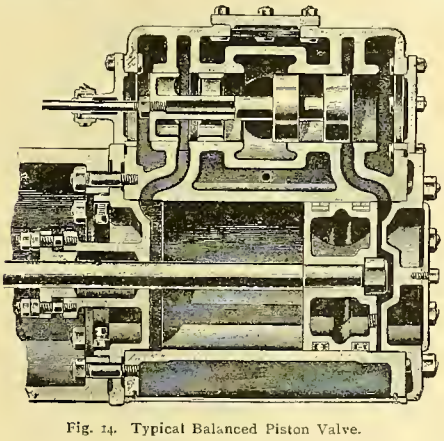

Fig. 14. Typical Balanced Piston Valve.

In practice the load on the engine will vary from time to time. In lighting work these variations will take place slowly, but with motor loads, especially in electric railway work, these changes will take place suddenly and often. The result is that many times the load is thrown on and off nearly instantaneously, and without a suitable speed governor the engine would change its speed suddenly. The governor should control the speed by regulating the supply of steam admitted to the cylinder, the object being to admit just enough steam to give the power necessary to maintain a given speed, whatever the load may be. In so far as this is accomplished quickly and effectively is the governor efficient.

1. Figs. 17 and 21 show curves prepared by Mr. Arnold in 1893 for Mr. W. J. Buckley's book on "Electric Lighting," and are reproduced by permission. Several similar curves of different types of engines were shown by the lecturer.

The high rotative speed of the first class of engines makes possible the adoption of shaft governors, which may be directly connected to the eccentric, and thus control the action of the valve effectively and conveniently.

Governors for use on electric power plant engines are usually one of the three following-named types:

1. The fly-ball centrifugal type is generally adopted for Corliss and other releasing-valve engines. It governs by communicating its motion, caused by a slight change of speed in the engine, through light rods and cams to catch mechanisms attached to the steam valves, as previously pointed out.

2. Centrifugal shaft governors are practically the same in principle and act in the same manner as the fly-ball governor, depending upon the speed of the engine for its action, can only be used with high rotative speeds.

High-speed Engines.—Close regulation is not the only advantage possessed by the high-speed engine. For the same horse power the higher the speed the smaller the engine. This results in compactness and, as a rule, lower first cost. The high-speed engines are convenient for "direct connection" to generators, which is now common practice, and they may also be belted directly to the dynamos without countershafting. They cause extra wear and tear, however, and require good lubrication and close attention while in use. Owing to the high rotative speeds a larger amount of steam must be used to provide a suitable cushion at the end of

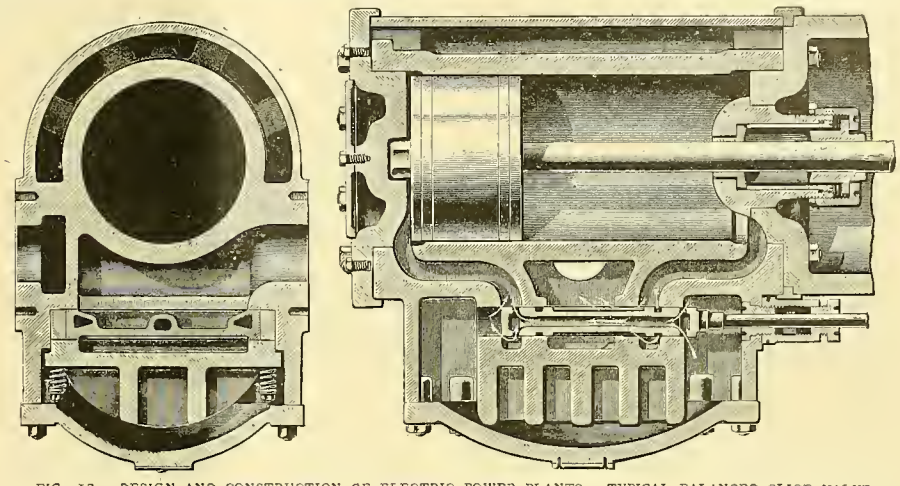

FIG. 13. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL BALANCED SLIDE VALVE.

type, except that they are mounted in a vertical plane on the main shaft of the engine and are attached directly to the eccentric which drives the main cut-off valves of the engine. Fig. 18 shows a typical governor of this class. Two masses or weights are pivoted in such a way that any increased speed will cause the weights to fly outward and by their movement revolve the eccentric around the shaft in the direction of rotation and close the admission valve earlier in the stroke. When the load is thrown upon the engine the tendency to slow down allows the springs which are attached to the weights to come into action and by retarding the eccentric cause the admission valve to cut off later in the stroke. Fig. 19 (p. 273) shows another kind of the same type of governor, the only difference being in the method of handling the eccentric. In this kind the eccentric is thrown across the shaft and its stroke constantly varied to correspond with the load on the engine instead of being revolved around the shaft, as in Fig. 18. For single-valve engines the type shown in Fig. 19 is preferable, as it does not affect the exhaust by excessive cushioning as seriously as when the stroke of the eccentric remains constant as in Fig. 18. For engines having independent exhaust valves the type shown in Fig. 18 is unobjectionable except on account of its slightly increased resistance to quick action, owing to friction. Either of these governors may be adjusted to maintain the speed at any desired rate by varying the tension of the springs or by changing the lever arm of the weights.

3. Another type of shaft governor, shown in Fig. 20, is called an inertia governor. The controlling effect is secured by the "inertia" of weights, which, by means of springs, are adjusted to maintain a certain position with respect to a fixed point on the flywheel, when revolving

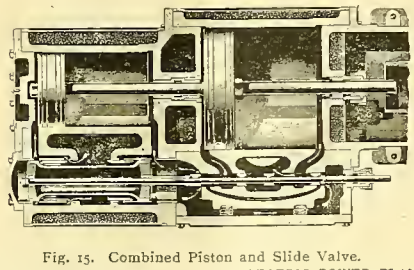

Fig. 15. Combined Piston and Slide Valve.

at the desired speed. Any retardation of the rim of the wheel, caused by a sudden increase of load, will cause the lever arm, of which the weights are a part, to move forward in the direction of rotation faster than the wheel to which it is attached, resulting in a sudden opening of the steam valve, as the valve rod is attached to a pin on the arm, as shown. In like manner the inertia of the arm or weights prevents the sudden opening of the valve when the engine is relieved of its load. This type of governor has the same effect upon the valve as the one shown in Fig. 19, inasmuch as it throws the eccentric across the shaft, and is coming into general use quite rapidly, on account of its good regulating qualities, its simplicity and its low first cost.

The great advantage of the flywheel governor is that it is compact and directly attached to the engine shaft, which insures reliability and prompt action. The shaft

each stroke for the moving parts. The extra steam required more than offsets the saving in the losses of cylinder condensation which result from the quick strokes of the piston.

Low-speed Engines are usually of the independent-valve type, such as the Corliss, and run at 75 to 150 revolutions per minute. They are usually horizontal, can be made in large sizes and are very reliable in operation. They are governed usually by a fly-ball or spindle governor, which is connected either by a belt or shaft to the main shaft. This governor can cause the cut-off to occur at any point, from the beginning up to nearly half the full stroke, which gives a wide range of power, and is satisfactory for engines operating arc lights or on loads which do not fluctuate. When the engines are to be used for driving electric railway motors or other variable loads which are liable to call for an excessive amount of power for short periods, engines of the Corliss type should be provided with two eccentrics and wrist-plates, one of which should operate the exhaust valves, with the other arranged to operate the steam valves, so that steam can follow the piston to three-fourths stroke if necessary. This cannot be done with one eccentric on account of its position on the main shaft when properly set to operate the steam valves.

The result of the usual valve mechanism with the low-speed engine is high steam economy. These engines have little wear and require the minimum of attention.

The disadvantages are that the cut-off is not adapted to high speeds on account of the non-positive action; therefore the engines must be considerably larger for a given horse power than with higher speed types. This results in a larger amount of floor space to be provided and entails a greater first cost per horse power of plant.

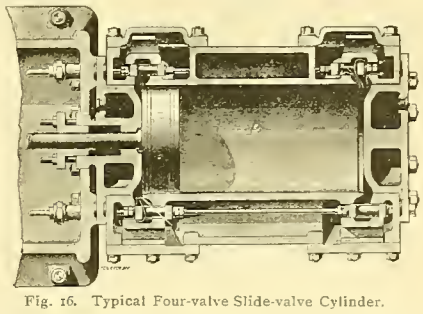

Fig. 16. Typical Four-valve Slide-valve Cylinder.

Medium-speed Engines are a "cross" between the high and low-speed types. If they are large, they resemble the Corliss type; if they are small, they will approximate toward the automatic high-speed class. Engines of this class are frequently vertical, and when built on this plan have the advantage of occupying a minimum amount of floor space for a given horse power. The tendency of the present time seems to be toward medium-speed engines—the speed ranging from 100 to 150 revolutions per minute. However, no strict line of difference can be laid down between the types mentioned.

Economy of Water Consumption.—In regard to actual economy of water consumption per indicated horse power, the table following this paragraph is given. It represents very fairly what may be expected of the various types of engines already discussed. The first

numerical column in the table gives what is thought to be a fair range for each particular type, but it is to be understood that no arbitrary limits can be established, as under very favorable conditions each type may show slightly better results than given in the table. Special test conditions are, unfortunately, seldom continued in actual operation, and the second column has been added to show what may reasonably be expected in everyday actual operation.

Table Showing Water Consumption per Indicated Horse Power.

Type of Engine—	General range.	Working average.
Simple single valve non-condensing	30-40	33
" four " "	25-30	28
" single " condensing	20-30	24
" four " "	18-25	21
Compound single " non-condensing	22-30	25
" four " "	18-25	22
" single " condensing	16-24	20
" four " "	14-23	18
Triple single " "	13-20	17
" four " "	12-18	15

Several things may be learned by studying the figures in the table. It will be noticed that compound engines show a saving over simple engines of between 20 and 30 per cent., the largest saving being shown in engines of the non-condensing class. Condensing over non-condensing engines show a saving of between 20 and 35 per cent. Thus, condensing effects about the same saving as compounding. The gain from condensing is more marked with simple engines than with compound. The four-valve engines show an advantage over the single-valve type of about 10 to 15 per cent. It is to be noticed that the greater percentage of gain from independent valves is obtained in simple engines, which result is probably due to the fact that in compound and triple expansion engines the effects of condensation due to the variation of steam temperature are much less marked than in simple engines. It will be noticed that the water consumption which may be expected of the best triple-expansion condensing engines is less than one-half of that of the simple non-condensing type.

The figures given in the table are for engines of comparatively large power, ranging between 200 and 500 horse power, working at their most economical point of cut-off and on steady loads. Unfortunately, this is an ideal condition seldom reached in the electric power station, for here, instead of a uniform and steady load, we have to contend with a demand which is subjected to many variations. And then, too, as the output of the engine departs from its rated capacity in either direction its efficiency falls off rapidly. Fig. 21 shows this condition graphically for a simple non-condensing engine of the single-valve type.

In this curve the efficiency of the engine at its rated capacity and at its most economical point of cut-off has been taken as 100 per cent., and the ratio of the water consumption at other loads to that at full load is taken as the measure of efficiency. The curve was drawn from information supplied by indicator cards, the dots showing the points at which cards were taken. It will be noticed that between 75 per cent. load and 125 per cent. rated load the efficiency varies comparatively little, but beyond these points it decreases rapidly, and that the decrease is much more rapid for low loads than for overloads.

Fig. 17 represents also an efficiency curve for a single-cylinder condensing engine working under a steam pressure of 100 pounds. In this case the indications were carried further, and we have the result in efficiency at 100 per cent. overload.

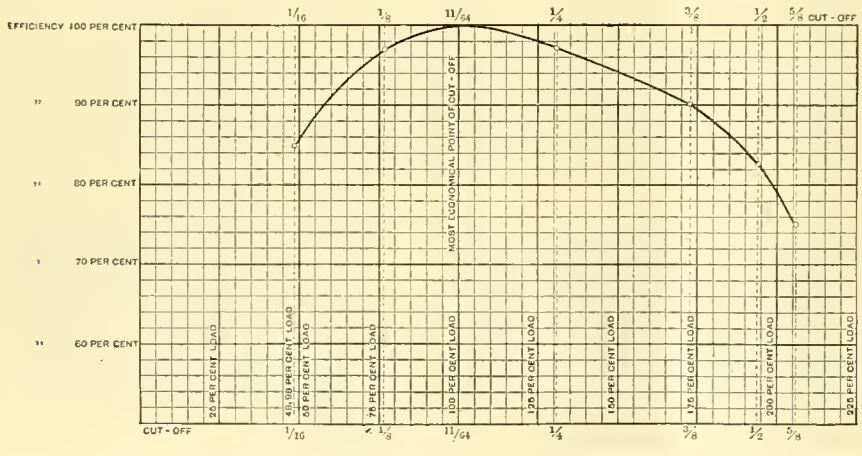

FIG. 17. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—CURVE SHOWING ECONOMICAL POINT OF CUT-OFF.

These curves are simply types of the efficiency obtained with any engine on varying loads, although the loss in efficiency with engines of the Corliss type is somewhat more marked at points below 50 per cent. of their rated capacity.

Selection of the Engine.—With these facts before us it is easy to formulate the rule that with a variable demand the size of the engine cylinders should be such as to give the best economy at average load. The cylinder, however, is the only part of the engine which should be proportioned for average conditions, and especially should all moving parts subjected to wear and strain be of ample size to operate successfully under the maximum possible demand. The choice of the actual size of the engine unit for any particular case is to be considered at a later time, when the principles just mentioned will be applied.

But it is not a question of economy alone which will determine the choice of the type of engine for any particular case, though economy is one of the most important considerations. The factors in the cost of the production of electrical energy were pointed out in Lecture II. In the selection of no part of the power station equipment should the relation and value of these different factors be better understood than in the choice of the engine and the method of driving the electric generators therefrom.

The designer of power stations is frequently called upon to decide between the condensing and non-condensing, between the Corliss and high-speed or other types of engines, and he should be in a position to decide intelligently. The economy to be gained by compounding and condensing are understood, but the question will often arise whether the extra investment in engine and condensers will be justified by the saving in fuel. If coal is cheap, the time in which the station operates each day is short, or water is difficult to obtain, it is evident that the higher priced steam equipment will not pay; but often the conditions are such that to the most experienced engineer the question of the proper selection is a puzzling one. A very instructive comparison of the cost of a delivered horse power by different types of engines operated under practical conditions was made some time ago by Dr. Chas. E. Emery and may be found in the *Transactions* of the American Institute of Electrical Engineers, March, 1893. In this comparison due allowance was made for the fact that the better the engine economy the smaller would be the boiler capacity required. The cost of a plant complete to develop 500 horse power for 308 days of 10 hours each was determined for each style of engine, and to the interest and depreciation on the plant were added in each case the cost of fuel required, the cost of labor, supplies, repairs, insurance, taxes, renewals and other current expenses. The result of this particular comparison seems to show that the compound condensing engine will deliver a horse power hour cheaper than any other type.

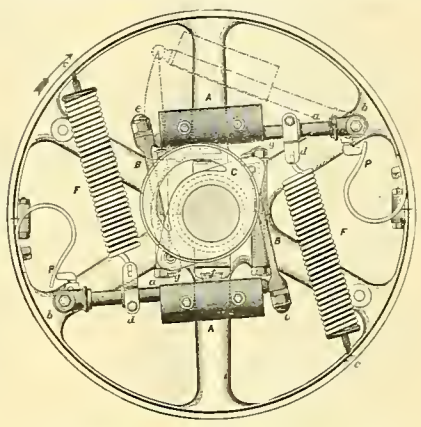

FIG. 18. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL CENTRIFUGAL SHAFT GOVERNOR FOR REVOLVING ECCENTRIC AROUND SHAFT.

The one great drawback to the adoption of the compound or triple-expansion engine is the amount of water required for condensation purposes. This amount can be calculated from the formula

$$Q = \frac{W\,H}{R}$$

Where W = Weight of steam condensed.
H = Heat units given up by one pound of steam in condensing.
R = Rise in temperature of the cooling water.

This formula is applicable to both jet and surface condensers. The usual allowance is for between 30 to 35 times as much water for condensing as is evaporated in the boiler. We have seen that a 200 horse power triple-expansion engine will require at least 3,000 pounds of water per hour. For condensing purposes, then, there would be required about 100,000 pounds of water. The necessity of locating the station near a natural source of water supply is thus given added emphasis, for a water works system would hardly be expected to furnish this enormous supply of water. In case of a "dry land" plant, where conditions make it impossible to secure water from a natural source, expedients for cooling the condensing water are occasionally resorted to. These consist of evaporating reservoirs, "cooling towers," etc., by means of which the water from the condenser is reduced to about the temperature of the atmosphere by being spread out over a large surface, which in the cooling towers and like appliances is obtained by means of deflecting plates, pans, screens or tiling.

After the decision as to whether the engine is to be simple, double or triple compound has been reached, there will be a great variety of other considerations which enter into the selection of the special type to be used.

In a later lecture the arrangement of the plant for particular cases is to be discussed, when the influence of such items as the amount of real estate available, the size and shape of the building, the "layout" of the piping, etc., will be considered.

Questions involved in the selection of the system for driving the generators from the engines will be considered in the lecture upon "Connections between Engines and Generators," when the advantages and disadvantages of shafting, belting, rope driving and direct connection" will be pointed out. That discussion will naturally involve the consideration of economy, cost and desirability of the different types of engines, and until we have a fair understanding of all the conditions external to the engine itself which enter into its selection general remarks upon the advantages of this or that type will be of little use.

In order that we may have a somewhat definite understanding of the principal dimensions of the vital parts of any steam engine, however, the following rules are given as some of the things which the designer of a plant ought to know:

Rule 1. That for safety the thickness of the metal in the barrel of the cylinder should be not less than given by the formula

$$t = \frac{p\,d}{2f}$$

Where p is the maximum steam pressure, d is the diameter of cylinder in inches and f is the safe working stress of the metal per square inch. If the cylinder is of gray cast-iron the value of f may be taken as 1,850, and if due allowance is made for reboring at least twice when worn, the formula may be used in the following form:

$$t = \frac{p\,d}{3{,}700} + .5'' \text{ to } \frac{p\,d}{3{,}700} + .75''.$$

Rule 2. That the diameter of the steel piston rod should not be less than determined by the following formula, which is due to Marks, and which has stood the test of successful practice:

$$d = .03525\ \sqrt{D^2\,l^2\,p}.$$

Where D is the diameter of the cylinder in inches, l is the length of the piston rod in inches, and p is the maximum steam pressure in pounds per square inch.

Rule 3. That the steel used for the different parts of an engine should be of the best quality of annealed open hearth steel having the following properties:

	Carbon.	Tensile strength.	Elastic limit.	Average elongation.
For crank pins, cross-head pins and similar parts.	*.45 of 1%	80,000 pounds	40,000 pounds	17%
For shafts.....	.30 of 1%	65,000 pounds	32,000 pounds	20%
For connecting rods, piston rods and similar parts.	.25 of 1%	58,000 pounds	27,000 pounds	28%

*None of these should contain over .04 of one per cent. phosphorus or sulphur.

Rule 4. That the ratio of the length of the connecting rod to the stroke of the piston should not be less than 2½ to 1 (preferably 3 to 1), on account of the irregularity introduced into the valve motion of the engine, due to what is termed the angularity of the connecting rod. (See any good text-book on valve motion.)

Rule 5. That the pressure per square inch of rubbing surface upon the guides and cross-heads should never exceed 100 pounds per square inch. The area of the slides may be found from the formula

$$A = P \tan \theta \div p_0.$$

Where P is the total pressure on the piston, obtained by multiplying its area by the initial steam pressure per square inch, angle θ is the angle whose sine = half the stroke of piston ÷ length of connecting rod, and p_0 is allowable pressure upon the guides per square inch.

Rule 6. That the mean pressure per square inch on the crank pin and cross-head pin should not exceed 500 pounds and 1,200 pounds respectively per square inch, the pressure being figured upon the rectangle bounded by the diameter and length of the pin.

Rule 7. That the pressure per square inch on the main and outboard bearings of an engine should not exceed 150 pounds. The value of the pressure upon the bearings may be taken as a resultant of the load due to the weight (W) of the shaft, flywheel, armature, etc., and

the mean pressure (P) from the piston. The resultant R may be calculated by the formula

$$R = \sqrt{W^2 + P^2}$$

for horizontal engines and R=W+P for vertical engines. In case of a generator armature keyed to an overhanging engine shaft, the weight of the armature should not only be considered, but some allowance must be made for the magnetic pull which will result if the armature is not exactly in the center of the fields. By wear or otherwise the center line of the armature may become displaced slightly, and an eccentricity of $\frac{1}{16}$ of an inch will cause a magnetic pull which should be estimated as equal to the weight of the armature.

Rule 8. That the diameter of the main shaft should not be less than the value obtained by the formulas herewith given. If the shaft were subject to twisting only we have T=the twisting moment on the shaft in

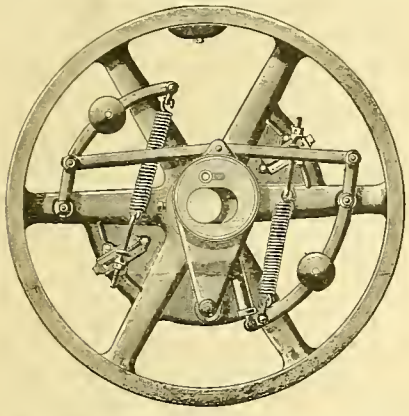

FIG. 19. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL CENTRIFUGAL SHAFT GOVERNOR FOR THROWING ECCENTRIC ACROSS SHAFT.

inch-pounds, balanced by the moment of resistance of the shaft to twisting, which is:

$$\frac{3.1416}{16} D^3 f,$$

so that

$$T = \frac{3.1416}{16} D^3 f = .19635\ D^3 f$$

whence

$$D = \sqrt[3]{\frac{16\ T}{3.1416\ f}} = 1.72 \sqrt[3]{\frac{T}{f}}$$

where D is the diameter of the shaft in inches and f is the maximum shearing stress in pounds per square inch. The value of f may be taken as 9,000 pounds for wrought iron and 13,500 pounds for steel. T, the twisting moment in inch-pounds on the shaft, may be found directly from the indicated horse power, as follows:

$$T = \frac{12 \times 33000\ H}{2 \times 3.1416\ N} = 63025.2 \frac{H}{N}$$

where H is indicated horse power and N is speed of shaft in revolutions per minute. When the shaft is

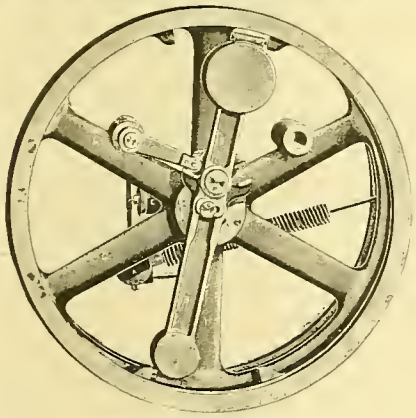

FIG. 20. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL INERTIA GOVERNOR.

subject to both twisting and bending at the same time, as is the case with engine shafts, and especially flywheel shafts and shafts carrying a generator armature, the diameter is found by first calculating the equivalent twisting moment. This is given by Rankine as follows:

$$T_1 = B + \sqrt{B^2 + T^2}$$

where B is the bending moment on any section and T is the twisting moment, as before. The bending moment B may be found, in the case of an overhanging crank, by multiplying the maximum pressure in pounds on the piston by the distance in inches between the center of the crank pin and the middle of the engine bearing. In the case of a flywheel or armature shaft having an outboard bearing, the bending moment is found by treating the shaft as a beam, supported at both ends and loaded at one or two points. The weight each bearing is to sustain, due to the weight of the flywheel, the pull of the belt or the weight of the armature, with due allowance made for magnetic pull, is determined, and this amount in pounds is multiplied into the distance between the middle of the bearing and the point which may be taken as the point of application of the resulting load upon the shaft. The equivalent twisting moment T_1 is substituted in the formula already given.

$$D = 1.72 \sqrt[3]{\frac{T_1}{f}}$$

Kent has derived the useful rule from results by the usual formula that the diameter of the shaft = .43 × diameter of the cylinder. For simple Corliss engines the rule that diameter of shaft = one-half the diameter of cylinder — $\frac{1}{16}$ inch is sometimes given.

Large engine shafts are preferably made hollow. In the smaller sizes they are bored out, while very large shafts are forged hollow. The interior of a shaft is liable to be composed of defective material, as the forge hammer has little effect upon it, and consequently the central portion may be removed without materially affecting the strength, while at the same time a reduction in the weight is made. If D is the diameter of a solid shaft and D_1 and D_2 the external and internal diameters respectively of a hollow shaft, they will have the same strength when

$$D^3 = \frac{D_1^4 - D_2^4}{D_1}.$$

It is safe to assume that 15 per cent. greater strain can be allowed per square inch of metal in a hollow shaft than in a solid one, on account of the removal of initial strains or on account of the metal being more thoroughly worked under the hammer, and this makes it possible to show very often that hollow shafts are as strong or stronger than solid ones.

Rule 9. That the clearance volume in the ports and end of cylinder of any simple engine or the low-pressure cylinder of a multiple expansion engine should not exceed 10 per cent. of the volume described by the piston in a single stroke for high-speed, short-stroke engines and three per cent. for low-speed, long-stroke engines. In the highest types of these engines the clearance is reduced to eight per cent. and two per cent. respectively.

Rule 10. That the horse power of a simple engine is calculated from the well established formula

$$\text{H. P.} = \frac{P\ A\ S}{33{,}000}, \text{ where}$$

P = The mean effective pressure on the piston in pounds per square inch.
A = Area of piston in square inches.
S = Piston speed in feet per minute.

For different points of cut-off the mean effective pressure may be taken as follows:

$\frac{1}{8}$ stroke	= initial pressure	(absolute)	.....	×	.385
$\frac{3}{16}$ "	= "	"	.....	×	.500
$\frac{1}{5}$ "	= "	"	.....	×	.522
$\frac{1}{4}$ "	= "	"	.....	×	.596
$\frac{1}{3}$ "	= "	"	.....	×	.699
$\frac{3}{8}$ "	= "	"	.....	×	744
$\frac{1}{2}$ "	= "	"	.....	×	.847
$\frac{5}{8}$ "	= "	"	.....	×	.919
$\frac{2}{3}$ "	= "	"	.....	×	.937
$\frac{3}{4}$ "	= "	"	.....	×	.966
$\frac{7}{8}$ "	= "	"	.....	×	.992

From the result obtained by the above table deduct the mean absolute back pressure to obtain the mean effective pressure from which to calculate the power of the engine. In non-condensing engines this would be the atmospheric pressure of about 15 pounds, plus two to four pounds, depending upon the type of engine and the conditions under which it is relieved of its exhaust.

Rule 11. That the power of a compound or multiple expansion engine is determined from the dimensions of the low-pressure cylinder, the speed of its piston and mean effective pressure of the engine as a whole, the functions of the other cylinders being to divide the expansion of the steam into two or more intervals, in each of which an equal amount of work is done. The method of determining the power of a compound or multiple expansion engine is somewhat laborious, if extreme accuracy is required, and it is not thought best to introduce it here. A good rule to remember (given by Kent), which will answer for all practical purposes, is that the horse power is equal to the square of the diameter of the low-pressure cylinder, divided by 2, when the mean effective pressure is 35 pounds per square inch and the piston speed 600 feet per minute, which values are the average of present practice. If these values change, the result will be changed proportionately.

Rule 12. That a very good formula for the weight of the flywheel is by Theiss, as given in Kent's handbook as follows:

$$W = C \frac{d \times \text{I. H. P.}}{V^2 \times n}$$

Where d = Co-efficient of steadiness.
V = Mean velocity of flywheel rim in feet.
n = Number of revolutions per minute.
C = A co-efficient dependent upon the point of cut-off.

$$\text{The value of } d = \frac{\text{normal velocity}}{\text{maximum velocity—minimum velocity}}.$$

The allowable variation is usually limited to two per cent. The value of C depends upon the point of cut-off, and the ratio of the length of stroke to connecting rod. This latter ratio is usually about $\frac{3}{5}$. With this ratio the value of C may be taken as follows:

Point of Cut-off in Fractions of Stroke.

.10	.15	.20	.25	.33
C = 241,500	230,000	218,500	207,000	184,000

It is the usual practice to allow not more than 1,000 pounds per square inch tension in cast-iron, and 5,000 in wrought-iron. The velocity of the cast-iron rim is usually kept below a mile per minute or 88 feet per second. The maximum allowable practice is a speed not exceeding 100 feet per second. A study of flywheel accidents seems to show that more accidents have occurred to engines of slow rotative speeds than to high-speed engines. This can be accounted for in a number of ways. With slow-speed engines the wheels are necessarily much larger and therefore harder to build. Slow speed engines govern much less closely than high-speed engines, and a change in the number of revolutions causes a correspondingly greater proportionate increase in centrifugal force. Too much care cannot be exercised in the design, construction and inspection of flywheels, for the record in this line of engineering seems to show a remarkable number of failures.[1]

[The next lecture will be on "Piping."]

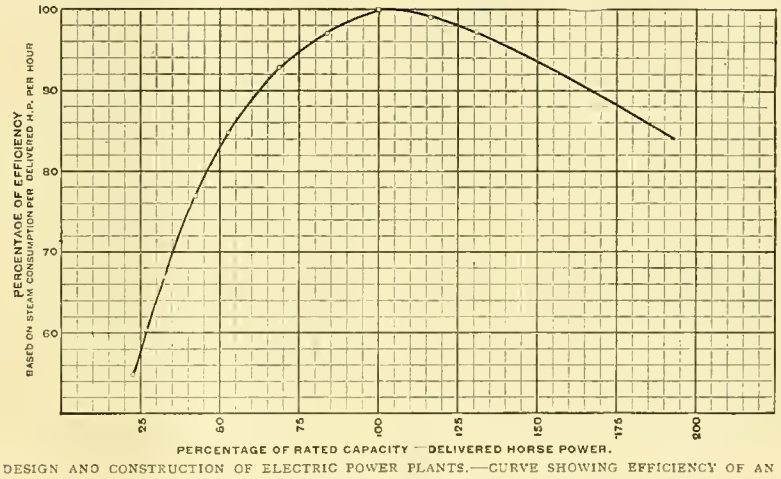

FIG. 21. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—CURVE SHOWING EFFICIENCY OF AN ENGINE AT DIFFERENT LOADS.

Electrical Section of the Trans-Mississippi and International Exposition.

Prof. R. B. Owens, the head of the Department of Electrical and Steam Engineering of the University of Nebraska, has been appointed commissioner for the electrical section of the Trans-Mississippi and International Exposition, to be held in Omaha next year, beginning in June and ending in November. Prof. Owens is excellently well qualified for the duties of this responsible position, and he will have full charge of the work of organizing and superintending the electrical department. Thoroughly capable from a technical point of view, the newly appointed commissioner has also the energy and executive ability of a man of affairs, together with valuable exposition experience gained while serving as a judge for the electrical department at the World's Fair. The appointment is a good one and will meet the hearty commendation of the electrical fraternity.

In connection with the exposition it is proposed to attract to Omaha next year as many meetings of learned or technical societies as possible. It is thought that this arrangement will be advantageous both to the societies and to the exposition. Among others, the American Institute of Electrical Engineers will be asked to hold its annual meeting of 1898 in the Nebraskan metropolis. It will then be six years since the Institute held a general meeting in the West.

1. The lecturer described the different types of steam turbines and gave the results of tests, but as this type of machinery is not in general use in this country the treatment of the subject is omitted in this abstract.

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ARRANGEMENTS for the annual gathering of street railway men have been completed and the programme adopted. The principal features are outlined in another column. At the head of the list of subjects to be considered is that of "Municipal Ownership of Street Railways." At the present time this is probably one of the most important problems that confronts the street railway interests of the country, and the expression of views of practical men that is expected should certainly prove a very instructive feature of the proceedings.

In this connection it may be well to call attention to the fact that there is quite a difference in the methods pursued by the American Street Railway association and other organizations of a somewhat similar character. The street railway convention will be held in October and the members are informed in May of the principal subjects to be discussed so that those who are particularly interested or have in their possession valuable information bearing on any of these topics may prepare to contribute to the discussion. In other organizations the publication of the programme is generally delayed until the last minute. This is particularly true of the National Electric Light association. Last year the programme was scarcely ready for distribution at the meeting, and up to the present time, although there have been many inquiries, it has been impossible to give any definite information as to the programme for the meeting next month. This may be due in part to lack of proper organization, but the principal blame should be placed upon those members who are invited to contribute papers and who do not comply with the requirements of the association. Probably this may explain in a measure the lack of interest that is often noticeable at the meetings of the National Electric Light association. If announcement could be made sufficiently in advance to insure the presence of those who were particularly interested in the subjects to be discussed the conventions would be much more valuable.

PRIVILEGES now enjoyed by telegraph companies under special acts of Congress may be extended to telephone companies under certain conditions, and at times the rights conferred by the federal law may prove of inestimable value. Judge Goff of the United States Circuit Court in the Eastern District of Virginia has handed down an important decision in the case of the Southern Bell Telephone & Telegraph company against the city of Richmond. The company, it was stated, was duly incorporated under the laws of the state of New York. Its wires, poles and instruments, as located and used along and over the streets of the city of Richmond, it was further alleged, were so located and used under the provisions of, and were protected by, the act of Congress, approved July 24, 1866, entitled "An act to aid in the construction of telegraph lines, and to secure to the government the use of the same for postal, military and other purposes," which provided that any telegraph company then or thereafter organized under the laws of any state, on complying therewith, should have the right to construct, maintain and operate lines of telegraph over and along any of the military and post roads of the United States.

The pivotal point of the case was as to whether the company was entitled to the rights and benefits claimed under the federal law. It did business in, through and between several states. It also set up the contention that it maintained a telephone office in Richmond, connected by wire with a large number of subscribers, all of whom were connected with the office of the Western Union Telegraph company in that city, and that all such subscribers might, and many of them did, transmit through their instruments connected with the wires, and through the telephone company's office, to the Western Union Telegraph company, messages addressed and intended to be sent to other states and foreign countries, under an agreement that existed between the two companies. Under such circumstances, Judge Goff held that the first mentioned corporation was both a telephone and telegraph company, and clearly entitled, if it had complied with the conditions thereof, to claim the benefits and protection of the act of Congress, and that the city could not require it to remove its lines from the highways occupied in accordance therewith, though it could tax and regulate them.

TEN years ago the first serious effort toward the establishment of a central station for supplying incandescent electric lighting upon a large scale commercially in this city may be said to have been made in the formation of the Chicago Edison company. The new enterprise was not considered with special favor by conservative investors, but was regarded by them in the light of a speculative venture. At that time electric lighting was numbered among the luxuries within the reach of comparatively few in this community. The cost as compared with gas seemed prohibitive. The superiority of electricity as an illuminant was admitted, but in spite of many advantages the question of expense appeared to be an insurmountable obstacle to its general adoption. The local company was hampered at the start by regulations of the municipality which required the burying of all electric wires within the business district, and this rule, it must be remembered, was of far greater importance at that time than it is to-day. The system of underground distribution had not been completely worked out and the new company was confronted with many problems that required the expenditure of much time and study and entailed great expense before a satisfactory solution was reached. The difficulties and disappointment that pioneers in underground construction experienced can only be fully appreciated by those who participated in that work. But the promoters of the enterprise never faltered; they persisted in their belief in the ultimate triumph of electricity over other forms of illumination, and they showed their faith in the enterprise in which they had engaged by providing the financial support for the development of a thorough system of electrical distribution. The experience thus acquired has proved of inestimable value to the electric lighting industry, and the entire community has been placed under a debt of gratitude to those who were indentified with this work.

In view of these facts, it is pleasing to reflect that these gentlemen have enjoyed substantial reward for the services they have rendered the public, and have not been forced to content themselves with empty honors. Careful business management has marked the course of this corporation and its success as a commercial enterprise is largely due to this fact. The data presented on another page in this issue is convincing proof of the wisdom of the policy adopted. It shows, too, how the business has developed and expanded, how new territory has been invaded and districts already developed absorbed. This constant development, absorption and extension has made many changes in organization and methods necessary, until, almost imperceptibly, there has taken place a complete transformation, and in the Chicago Edison company of to-day one can scarcely recognize the enterprise that was started with so many misgivings 10 years ago.

IT is evident that there is serious misapprehension of the scope and importance of the decision of the Supreme Court of the United States upon the Berliner patent. There is nothing in the opinion to warrant the statement that a "new lease for monopoly" is granted the American Bell Telephone company by the ruling in the Berliner case. What the Supreme Court does say is that the charges made by the government regarding corruption and other illegal practices on the part of the owners of the patent while the application was pending have not been sustained, but other grounds upon which the government asked to have the patent revoked have not been passed upon. This decision means that the Bell company is officially exonerated from all charges of corruption in this proceeding, but it does not satisfactorily explain why the application was "hung up" in the Patent Office for such an unusual period, why the applicant was permitted to amend the original specification so as to change the character of the application entirely, nor why a patent should be granted upon a device that was already covered by another patent. These are considerations which will have to be taken into account and satisfactorily adjusted when the Bell company attempts to enforce its claims of infringement against independent corporations. It will be seen, therefore, that so far from possessing a "new lease for monopoly" by reason of the decision of the Supreme Court, the Bell company has in reality made no practical gain in the struggle for supremacy in the telephone field. In fact it has failed to take advantage of an excellent opportunity to determine the validity of the Berliner patent, and as a result the question is in the same condition exactly that it was before the government suit was begun. It will be necessary to fight over again the battles which the company engaged in earlier in its history, but it will be under disadvantage now in having to face a stronger combination than was arrayed against it when it succeeded in sustaining the original Bell patent. It will find, too, that experience has removed much of the terror of patent litigation and that a petition for injunction by the Bell company will not create the consternation in the owners of anti-Bell exchanges that such proceedings formerly did. In a word the American Bell Telephone company is not feared as it was in the early days of the art, and its action in connection with the present litigation, in evading a judicial decision upon the merits of the case, has not added to the public respect for the value of the patent under dispute. Aside from the false impression temporarily given by the misleading statements that have been published concerning this decision, it is hard to find the least advantage for the successful party in the action. During the last few years the independent companies have grown in spite of hard times, and to-day there are several hundred thousand telephones in use in exchanges that are not controlled by the Bell company. With such a phenomenal growth in the face of litigation it is not to be wondered that the independent forces view with satisfaction the spectacle of the Bell company evading by technicalities a decisive action. Confidence in its cause, it is contended, would certainly impel that powerful organization to use all its influence to secure an immediate settlement.

Chicago Edison Company.

The annual meeting of the Chicago Edison company will be held on Monday, June 14th. The fiscal year of the company ended March 31st, and the business and financial statement for the preceding 12 months is appended:

BUSINESS SUMMARY.

Gross income from electric current and merchandise sales		$1,548,608.10
Operating, repairs and renewals, and general expense		948,933.82
Net income from all sources		$ 599,674.28
CHARGES AGAINST INCOME.		
Interest on bonds and debentures	$180,333.98	
Dividends paid	397,518.00	577,851.98
Balance carried to surplus account		$21,822.30

STATEMENT OF ASSETS AND LIABILITIES.

Assets.

Plants, real estate and franchises	$8,630,330.51
Material in store-room and unfinished work unbilled	136,404.95
Accounts and notes receivable	197,799.24
Cash	206,540.74
	$9,171,075.44

Liabilities.

Capital stock	$4,975,900.00
Bonds and debentures	3,750,000.00
Accounts and notes payable	131,066.29
Open accounts	17,842.41
Depreciation account	200,000.00
Insurance fund	20,000.00
Surplus account	76,266.74
	$9,171,075.44

BUSINESS CONNECTED.

Incandescent lamps	208,954
Arc lamps	5,180
Motors (horse power)	6,824.7
Total equivalent in 16 candle power lamps, March 31, 1897	355,140
Total equivalent in 16 candle power lamps, March 31, 1896	315,732
Increase for fiscal year	39,408

This report shows a gain in both gross and net over the preceding year, and also a marked reduction in operating expenses as compared with the two preceding years. Important changes in the company's funded debt were made during the year as follows:

New five per cent. bonds issued		$2,267,000
Retired—		
Six per cent. debentures	$712,000	
Six per cent. first mortgage bonds	130,300	
Six per cent. bonds of Chicago Warehouse & Manufacturing company	125,000	
Six per cent. purchase notes	53,000	
		$1,020,300
Leaving balance of proceeds of bonds		$1,246,700

This balance has been applied to improvement of plant, extensions, etc. The company's unfunded debt shows a decrease of $175,229 as compared with the previous balance sheet. These changes leave the company with only the balance of the debentures, $1,483,000, and the $2,267,000 of new bonds outstanding. The bonds are part of the $6,000,000 authorized last summer, of which $3,733,000 more may be issued at any time for extensions and improvements or to retire the outstanding debentures. The remaining $1,024,100 may be issued only after an equal amount of capital stock has been issued and fully paid.

The price at which the Chicago Arc Light and Power company was taken over was $2,195,000, and the debentures were issued for this purpose. The Chicago Warehouse and Manufacturing company bonds were assumed as part of the purchase price of that company's leasehold. The purchase notes were issued in connection with the same transaction. The company's relation with the Sectional Electric Underground company are those of a lessee, it having the right to use that company's underground conduits and guaranteeing interest on its bonds in consideration of such use.

The policy of the company in making extensions and improvements has been not merely to meet immediate needs but to provide for future growth and also to produce and transmit current at the lowest possible cost.

The general depression has naturally had a marked effect on the company's business, and while it has earned its eight per cent. dividend it has not reaped the advantage which it would have obtained under normal conditions from its large outlays.

The fact that the company was formed 10 years ago and that its history has been a record of constant development, expansion and improvement, makes the following statistics, gathered by the *Economist*, of unusual interest at this time:

The authorized capital stock is $5,000,000, of which $4,975,900 is outstanding. The bonds of the company are divided as follows: First mortgage, five per cent., gold, due July 1, 1926, interest payable April and October at Merchants' Loan & Trust company, $2,267,000; debentures, six per cent., due January 1, 1913, interest payable January and July at Merchants' Loan & Trust company, $1,483,000; total, $8,725,900.

The mortgage securing the bonds shown in the table was executed July 1, 1896. It provides for an immediate issue of $3,500,000 of bonds, and for additional issues up to a limit of $6,000,000; but not more than a total of $5,000,000 shall be issued unless the company first increases its capital stock, so that the total amount of capital stock issued and fully paid shall at least equal the total amount of bonds issued. The mortgage creates a first lien on all the company's property and franchise, excepting a piece of property on Indiana avenue and its merchandise.

Aside from this mortgage the company has, from the beginning to date, issued the following securities:

At organization, April 29, 1887		$ 500.000
Increase authorized May 10, 1890	$ 250,000	
Increase authorized August 20, 1891	250,000	
Increase authorized May 11, 1892	500,000	
Increase authorized February 14, 1893	1,500,000	
Increase authorized February 21, 1893	2,000,000	
		4,500,000
Total authorized		$5,000,000

Of which $24,100 has not been issued.

In 1888 the company issued first-mortgage six per cent. bonds to the amount $130,300. These bonds have been retired.

In 1893, six per cent. debentures to the amount of $2,195,000 were issued. Of these only $1,483,000 are now outstanding.

In 1895 the company assumed $125,000 six per cent. bonds of the Chicago Warehouse & Manufacturing company in connection with the purchase of that company's property. These bonds have been retired.

In connection with the same purchase the company issued $53,000 six per cent. purchase notes. These notes have been retired.

National Electric Light Association.

A great many inquiries are being received at the office of the National Electric Light association regarding exhibits at the coming Niagara convention. For the benefit of those desiring to make an exhibit, it may be stated that no exhibition will be held under the auspices of the association, but from the tenor of correspondence and personal interviews, it is learned that many exhibitions will be made by associate members in the parlors and rooms of the hotel.

From organization, the amount of net earnings of the Chicago Edison company which would be available for payment of bond interest in each year has been as follows:

Year ending December 31, 1888	$ 23,621	Year ending December 31, 1889	$ 51,664
Year ending December 31, 1890	123,123	Year ending December 31, 1891	160,955
Year ending December 31, 1892	321,056	Fifteen months ending March 31, 1894	680,677
Year ending March 31, 1895	483,665	Year ending March 31, 1896	562,567
		Year ending March 31, 1897	599,674

EARNINGS.

	1892.	1893-94.*	1894-95.	1895-96.	1896-97.
Gross	$872,665	$2,141,779	$1,437,042	$1,461,084	$1,548,608
Operating expenses	551,609	1,461,102	*953,377	898,517	948,934
Net	321,056	680,677	483,665	562,567	599,674
Interest	6,798	171,934	155,128	158,135	180,334
Earned on stock	314,258	508,743	328,537	404,432	419,340
Dividends	90,000	219,119	319,038	389,382	397,518

*Fifteen months ending March 31, 1894.

The balance sheet for the last five years is here appended, and will be found interesting:

ASSETS.

	Dec. 31, 1892.	March 31, 1894.	March 31, 1895.	March 31, 1896.	March 31, 1897.
Plants, real estate, etc	$2,019,184	$6,035,279	$7,226,390	$7,705,517	$8,630,330
Work in progress, etc	141,427	219,095	135,959	109,915	136,405
Accounts receivable	199,109	238,891	199,422	190,329	197,799
Cash	110,035	254,286	207,749	48,920	206,541
Due from stockholders	.....	450,277	.....	.....	.....
	$2,469,805	$7,197,828	$7,769,520	$8,054,681	$9,171,075

LIABILITIES.

Capital stock	$1,500,000	$4,200,000	$4,947,300	$4,948,437	$4,975,900
Bonds and debentures	130,300	2,325,300	2,325,300	2,503,300	3,750,000
Accounts and notes payable	364,478	393,450	220,918	304,126	131,066
Open accounts	.....	21,818	12,244	19,711	17,842
Surplus	475,027	254,260	263,758	278,807	76,267
Depreciation account	.....	.....	.....	.....	200,000
Insurance fund	.....	.....	.....	.....	20,000
	$2,469,805	$7,197,828	$7,769,520	$8,054,681	$9,171,075

Supreme Court Decision in Berliner Case.

The long-looked for decision of the Supreme Court of the United States in the action of the government against the American Bell Telephone company to annul the Berliner patent was handed down on Monday, May 10th, and was favorable to the Bell interests, as it dismissed the charges of the government that fraudulent practices had been resorted to by the Bell company to keep the patent pending until the date of expiration of the original Bell patent was close at hand. The decision is essentially a Scotch verdict, and has no bearing whatever upon the merits of the controversy over the subject matter of the patent itself.

The opinion accompanying the decision was written by Justice Brewer; a dissenting opinion was filed by Justice Harlan, and no action was taken whatever in the case by Justices Gray and Brown, presumably on the ground that they had personal interests involved in the outcome of the case.

Briefly stated, the conclusions of the court on the subject of fraudulent delay in the Patent Office are as follows:

First—That before the government is entitled to a decree canceling a mechanical patent on the ground that it had been fraudulently obtained it must establish the fraud by convincing testimony.

Second—That an applicant for patent cannot be held responsible for the dilatory acts of the Patent Office officials unless the delay is brought about through his corruption.

Third—The evidence in this case does not tend in the least degree to show any such corruption.

Fourth—If the circumstances do not show that the delay on the part of the officials was wholly justified they do make it clear that it was not wholly unwarranted.

With reference to the arguments on the subject of the continuance of the telephone monopoly Justice Brewer repeated that there was no question that Bell's patent had expired, but it must be remembered that Berliner's rights were independent from those of Bell. If there should be a new invention upon the expiration of the Berliner patent the rights of its author could not be abridged to relieve the public. The inventor of the latest addition is entitled to full protection, and if the telephone company buys that invention it is entitled to all the rights which the inventor had.

The court dissented entirely from the views urged by counsel that the applicant for a patent was a quasi-trustee for the public, but held that an invention was the absolute property of its inventor. The government in order to make its case must establish affirmatively that the delay in the Patent Office was caused by the conduct of the applicant. It cannot rest on mere inferences, but must prove the wrong in such a manner as to satisfy the judgment before it can destroy that which its own agents have created. This requirement, it was decided, the government has failed to meet.

Another feature of the case to which attention was directed in the opinion was the influences under which the suit started, the indications that the purpose of striking down this patent was to give value to others, and that private competitors of the Bell company were seeking to injure a rival, not for the public good, but for the promotion of their personal interests.

Readers of the WESTERN ELECTRICIAN are familiar with the controversy over this now famous patent, and a brief enumeration of the principal points will be sufficient at this time. Emile Berliner filed an application for a patent upon a "combined telegraph and telephone" on June 4, 1877, but later the specifications were so modified that the application became really a new one. It is contended that Anthony Pollok, solicitor for the American Bell Telephone company, which had acquired possession of the Berliner invention, amended the application on September 1, 1880, "by striking out all the drawings, the entire specification except the preamble and signature, and substituting a new specification and claims which was not, however, signed or sworn to by Berliner or verified under oath until long afterward." Finally in this form the patent was granted to Berliner on November 17, 1891. It was pronounced at the time a valuable acquisition by the Bell interests, especially in view of the fact that the date for the expiration of the original Bell patent was near at hand.

The Bell interests were not permitted to rest in possession of their prize, for litigation was at once commenced in the name of the government to annul the patent on the ground of fraudulent collusion by the Patent Office employes with the Bell company, also on the ground that the device described lacked novelty and was already covered in a patent granted Berliner. The bill

was filed by Attorney-general Miller on February 9, 1893, in the United States Circuit Court for the District of Massachusetts at Boston. Upon the hearing decision in favor of the government was given. Appeal was taken to the United States Circuit Court of Appeals, where the decision of the lower court was set aside on the ground that the government had failed to sustain its charges of corruption and fraud and that the lower court exceeded its jurisdiction in assuming to pass upon the merits of the patent. The government carried the case to the Supreme Court and asked for a decision upon all the points involved. This would determine the case finally, it was argued, and in view of public interest it was contended that an early decision was imperative. On the other hand, the Bell company insisted that the question of fraud and corruption alone be considered, as the government appeal was based upon the ruling of the lower court. Accordingly, the Supreme Court passed on this point alone, leaving all other points to be determined by the usual process, when the Bell interests attempt to enforce their claims of infringement against the independent companies.

Naturally the decision has provoked considerable comment among telephone men. The views of several telephone men are appended.

W. A. Bisland, vice-president of the Western Telephone Construction company, Chicago, said:

Of course the Bell company will parade this decision as a great victory, and will allege that all persons who manufacture or use the Berliner devices will be open to suits for damages for infringement of the patent. Now, as a matter of fact, the question as to the validity of the Berliner patent is not touched upon in this decision, for the very good reason that that question was not before the court. Our company is prepared to show that the Berliner patent is invalid, and on that issue we will fight the Bell company in every court in the land. Our company has guaranteed to maintain at its own expense all suits brought against the purchasers of its apparatus for alleged infringement by such apparatus, and to pay all damages resulting from such suits. We have always lived up to our guaranties and propose to continue doing so. We will continue to manufacture microphones, not in defiance of the laws of the United States, but because we have information in our possession which will defeat the Berliner patent if our company or any of our customers should ever be sued for infringing it.

P. C. Burns, president of the American Electric Telephone company, Chicago, said:

The Berliner patent is now placed in the same category as any other patent. It must run the gauntlet of the ordinary defenses which may be interposed in a suit brought for infringement. We entertain the opinion and believe that this suit was instigated by the Bell company to dignify it and obtain a decision of the Supreme Court on one question only, which it knew could not be established adversely to it, and then use this decision on the one question only as a means of intimidating capital. We have no doubt that the patent will ultimately be declared invalid.

W. Clyde Jones, attorney for the Stromberg-Carlson Telephone company, Chicago, said:

The decision of the Supreme Court decides only the question of fraud, leaving all other questions, such as anticipation by the 1880 Berliner patent, to be determined by a subsequent infringement suit. The Circuit Court held the patent invalid on all the grounds, but the Appellate and Supreme Courts considered the question of fraud only. The decision puts the patent where it was in 1891, when granted, except that the only court passing upon all the grounds of invalidity declared the patent invalid. These same questions will arise in the infringement suit. The decision does not give the Bell company monopoly and does not settle the controversy.

The Standard Telephone & Electric company of Madison, Wis., telegraphed the following statement to the WESTERN ELECTRICIAN:

The Berliner patent decision simply acquits the Bell company of fraud and collusion in its issue. It will never be sustained on its merits, and we are anxious to at once try conclusions with it in a suit for infringement either against us or the users of our telephone.

Representives of the American Bell Telephone company's interests at Chicago, who were seen after the decision was handed down, declined to make any statement for publication as the full text of the opinion had not been received and the policy of the company had not been announced.

Proposed Duty on Carbons.

Senator Quay has introduced an amendment to the Dingley tariff bill providing that carbons for electric lighting, of 12 inches or less in length, shall be subject to a duty of $10 per thousand; while those in lengths of over 12 inches shall be subject to a duty of $10 per thousand for each 12 inches or fraction thereof, and carbons for electro-chemical and other purposes to a duty of 80 per cent. ad valorem.

A Röntgen Ray Tube with Automatically Adjustable Vacuum.[1]

By H. Lyman Sayen.

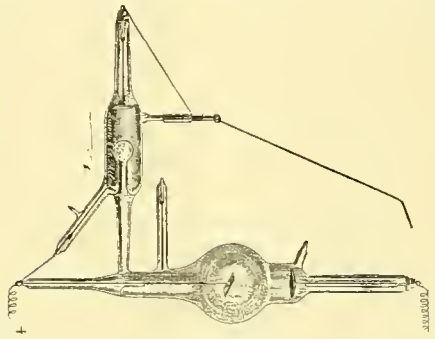
The most important and yet the most imperfect piece of apparatus that is necessary for the production of X-rays is the Crookes tube. It consists fundamentally of a cathode capable of focusing a stream of "radiant matter" upon a platinum plate, the whole being inclosed in a properly exhausted vessel.

Since the announcement of the focus tube in March, 1896, there have been few changes in the material arrangement of these parts. Many attempts, however, have been made to remedy one great defect which is inherent to Crookes tubes, and that is the gradual rise in vacuum subsequent to their constant use. I will briefly describe some of these methods and endeavor to show why they are inefficient.

Many makers provide their tubes with a little bulb opening into the main tube and containing potassium hydrate or other material which is capable of giving off gas on being heated. When the vacuum gets too high a spirit lamp is placed under the bulb and a small quantity of vapor is given off which lowers the vacuum the desired amount. It has further been suggested to use a resistance coil around the bulb and to regulate the heat by means of an auxiliary source of current.

Another scheme as suggested by Dr. William Morton of New York is to seal a small incandescent lamp on the main bulb, the two bulbs opening into each other, and to bring down the vacuum by passing an auxiliary current through the lamp filament.

Siemens & Halske of Berlin have recently put on the market a Röntgen ray tube in which the vacuum is adjusted in a most ingenious manner. A small bulb containing an internal electrode, to which external connection can be made, is connected to the main tube. This bulb contains phosphoric vapors which have the property of condensing when traversed by an electric current. To raise the vacuum the electrode of the bulb and the cathode are connected to the induction coil.



A RÖNTGEN RAY TUBE WITH AUTOMATICALLY ADJUSTABLE VACUUM.

Warming the bulb causes the phosphorous to revaporize and lower the vacuum.

In all these schemes the vacuum may be varied over wide limits and the life of the tube is increased to an indefinite extent, but as they all depend on the skillful manipulation of the operator, it is seldom that they accomplish the desired result. The vacuum in a Röntgen ray tube can only vary over very small limits, and being also dependent on the temperature of the tube, it is in a very unstable position. That is, if a tube starts to heat when running, the vacuum lowers and the tube takes more current due to the increased conductivity of the gas therein, lowering the vacuum still more, while a reverse condition of affairs takes place if the tube cools. So it will be seen that it is very difficult and often impossible to keep the temperature of the tube and to manage the regulating device to produce the desired result. One way of using these devices is to lower the vacuum the desired amount and to keep it low by running with the platinum hot enough to keep the vacuum down.

The ideal regulating device should possess the following qualities: It should act immediately, it should be independent of the temperature of the tube and it should keep the vacuum where first put.

Having in mind the difficulties mentioned and the qualties desired, Messrs. Queen & Co. authorized me to proceed in their laboratory with a series of experiments which have resulted in the device which I will now describe.

A reference to the illustration will make the operation of this device clear. A small bulb containing a chemical which gives off vapor on being heated and reabsorbs it when it cools is directly connected to the main tube and surrounded by an auxiliary tube which is exhausted to a low Crookes vacuum.

In the auxiliary tube the cathode is opposite to the above mentioned bulb, so that any discharge through it will heat this bulb. This cathode is connected to an adjustable spark point which may be placed at any desired distance from the cathode of the main tube. The main tube is exhausted to as high a degree as possible in the first place while running hot, and the chemical in the small bulb is rid of enough of its gas to insure its remaining high at all ordinary atmospheric temperatures.

In operating the induction coil is connected as usual to the main bulb. On starting the coil, the vacuum of the main tube being high, the resistance is also high and the current takes the path of the least resistance through the auxiliary tube, thereby heating the chemical in the small bulb. This will continue for a few seconds until a sufficient amount of vapor has been driven into the main tube to permit the current to go through it. After this only an occasional spark will jump across the spark gap to maintain the tube at the same vacuum. The vacuum may be set high or low by placing the spark point a considerable distance from or close to the cathode of the main tube.

I have here before you on the table a tube of this pattern connected to a large induction coil specially constructed for Röntgen ray work. The coil gives a 14-inch spark and runs in a most quiet manner on the 110 volt circuit. By means of a resistance in the base I can regulate the current in the primary to any amount desired up to the limit of the coil. This fluorescent screen, behind which I have placed a thick book, will show any difference of penetrability of the Röntgen rays due to difference of vacuum. On starting the current you see the main tube remains dark and the spark jumps across the spark gap. Almost immediately the large tube lights up. It is now possible to increase the current and you can see that it is possible to get the platinum anode brightly incandescent without lowering the vacuum in the least—as shown by the brilliant fluorescence on the screen. I shut off the current and bring the spark points together; on starting the coil the main tube lights up at a very low vacuum; so low that there is no fluorescence produced at all.

The tube has now the characteristic appearance of running on an alternating current. The reason for this is that the resistance of the tube is so low that the secondary of the coil is practically short-circuited and by its mutual induction decreases the self-induction in the primary, allowing the current to rise more quickly on the make, producing considerable current in the secondary in the reversed direction. This effect is not so noticeable on battery circuits because the impressed electromotive force is not so high on the make. I will not run much current through the tube at this point, because it blackens the bulb considerably, due to disintegrated platinum when the platinum becomes cathode.

If I put a short spark-gap in series with the tube and secondary, you will notice that the alternating effect disappears, and it is now perfectly safe to increase the current. I should advise all experimenters who desire to keep their tubes from blackening, that in using tubes where the platinum is the anode (and with platinum as the anode we get undoubtedly better X-rays), to use a similar spark-gap in this manner. The sparking distance should be greater than the coil will spark on the make, and it is especially desirable where it is necessary to run on low vacuum with 110 volt primary.

On separating the spark points, you see the vacuum rises slowly in the main tube until the spark prefers to jump across the gap. The tube now runs quite steadily without flicker, a small intermittent spark being sufficient to keep the vacuum down.

I will now connect the coil to the heating tube only and run it lightly for a few seconds, so as to drive considerable gas into the main tube. On connecting again to the main tube it will be noticed that the vacuum is so low that the gas is simply a conducting stream between the terminals, such as we recognize in a tube exhausted to a couple of millimeters of mercury.

Supposing we assume, after Sir William Crookes, that the vacuum necessary to produce X-ray effects is about one-millioneth of an atmosphere (this is a low enough assumption at any rate), this bulb then contains enough gas to fill this whole hall at that high vacuum, so that the life of such a tube, barring misuse, should be practically unlimited.

From even this most severe treatment, the tube rapidly recovers and is now working in its normal state.

I will conclude my paper this evening with a brief summary of the advantages which I think a tube of this kind possesses over the ordinary type.

First—Adjustable vacuum.

It may be set at any vacuum desired, from one so high that no current will penetrate it to one so low that the current would rather go through the tube than jump over a parallel spark gap of one-half of an inch. In a radiograph of the hand, for instance, it is desirable to use a low vacuum to secure the necessary contrast between bone and flesh, while in locating foreign metallic bodies in dense tissue it is desirable to use a high vacuum.

Second—Automatic regulation.

At whatever vacuum it is set it will remain so long as the coil is running, without any attention whatever from the operator.

Third—It will stand considerable energy without decrease of vacuum, consequently shortening the time of exposure necessary.

Prof. Arthur W. Goodspeed of the University of Pennsylvania has taken his best radiograph of the hip in three minutes with one of these tubes; he has also taken an excellent one in one minute. Dr. William M. Sweet, with the tube adjusted at high vacuum, has located foreign bodies in the eye, the pictures being taken perpendicularly across the head with an exposure of 30 seconds.

Fourth—A long lease of life.

1. Abstract of a paper read before the Electrical Section of the Franklin Institute, Philadelphia, April 27, 1897.

Alderman Kahler has secured the passage of an order calling on the commissioner of public works to compel the Chicago Telephone company to put all of its wires underground. The corporation counsel says that the six years of grace originally given to the telephone company have long since lapsed.

Western Union Finances.

The recent depression in the stock market, in which Western Union lost two points, has been taken by the *New York Herald*, which, it must be admitted, is not wholly disinterested, as an indication of the future value of these securities. This unfriendly critic says:

These are times to try the merits of corporations, and it seems as if the series of stock waterings attending the inflation of the Western Union's capitalization from $35,000,000 to $109,000,000 were beginning to bring retribution.

All the statutory laws passed against trusts and monopolies thus far have proved ineffectual, but natural laws, though slow in operation, work irresistibly to overthrow all attempts to establish permanent monopoly. On its practical consolidation with the Atlantic & Pacific Telegraph, in 1878, the Western Union company obtained a monopoly of the telegraphing business in the United States, and the rates it charged seem incredible to-day. In the following year the company distributed $6,000,000 of stock from its treasury in the form of a scrip dividend of 17 per cent. to its stockholders, thereby increasing the share capitalization to $41,000,000. But the profits of the monopoly, as is inevitable in such cases, acted as a premium for somebody to establish a competing concern. Jay Gould saw the opportunity and founded the American Union Telegraph company.

As a result of this competition, Gould succeeded in getting control of the Western Union, re-establishing the monopoly, and in January, 1881, made a scrip dividend that put that of his predecessors in the shade. The stock was increased to $80,000,000 at one stroke, $15,000,000 of the new issue being paid over for Mr. Gould's American Union lines, $8,400,000 for the Atlantic & Pacific, which the Western Union already controlled, and $15,500,000 being distributed gratis as a scrip dividend of 48½ per cent. to the Western Union stockholders, Mr. Gould and his friends naturally being the largest of these. Then Mr. Gould laid two ocean cables and made a combine with the other cable companies whereby a monopoly of the cable business was established, and the Western Union guaranteed dividends of five per cent., which it is still paying, on $14,000,000 of stock, representing Mr. Gould's two cables. Fifty cents a word was exacted from the cabling public until this monopoly was broken by the Commercial Cable company, which has reduced the rates one-half. But the new monopoly on the land lines was not permitted to rest, for the Mutual Union Telegraph company was started, and in 1883 the Western Union was compelled to purchase control of it by guaranteeing interest and dividends on its $15,000,000 of bonds and shares.

The balloon was being inflated too fast. Dividends were paid in 1886, not in cash but in scrip, which was taken up with $1,200,000 of stock issued in the following year. In November, 1887, $5,000,000 more was issued to take in the Baltimore & Ohio Railway company's telegraph lines, and in 1892 came a new inflation. The Western Union's stock capital was increased to a round $100,000,000, no less than $8,620,148 of their new stock being distributed gratis to shareholders, making the total amount distributed directly in scrip dividends about $32,000,000 in 13 years, to say nothing of the individual inflation of the companies taken in and their shares exchanged for Western Union or of the issues of bonds. With the competition of the Postal Telegraph company and the extension of the telephone service, the Western Union has not been able to exact enough money from the public to increase its income account in proportion with this rapid swelling of capital account. The following comparison of the capitalization and income for the years ending June 30, 1879, and 1896, shows this in a very striking manner:

	1879.	1896.
Stock	$35,068,575	$ 95,370,000
Bonds	6,138,166	14,053,208
Total capitalization	$41,206,741	$109,423,208
Income	4,269,778	5,897,980
Interest and sinking fund	470,584	933,958
Dividends	2,295,304	4,767,805
Totals	$ 1,503,888	$ 196,217

For nine months of the current fiscal year the earnings, as reported in the quarterly statements of the Western Union company, and which are partly estimated, were $4,232,987, as against $4,497,780 for the corresponding period of last year. Last year's earnings showed a surplus for the nine months of $191,481 over the dividends paid, whereas this year's show a deficit thus far of $72,973. The Western Union's contract with the Stock Exchange for privileges of the "floor" will expire June 1st, and unless it secures a renewal the dividends on its stock are likely to be reduced to a basis commensurate with the actual value of the property.

Boston's Gas Explosion.

Fire Marshal Whitcomb of Boston on May 3d made his report on his findings after a thorough investigation of the gas explosion of March 4th, at the corner of Boylston and Tremont streets, that caused 10 deaths, injured more than 50 persons, and destroyed much property. Mr. Whitcomb finds that the accident was due to the lax method of inspection pursued by the Transit Commission. Judge Ely of the Municipal Court found the accident due to the negligence of the Boston Gas company.

After speaking in his report of the causes that led up to the explosion, the fractured gas pipe, the chamber in which the gas collected, etc., the marshal speaks of the precautionary measures that might have been taken by the transit commission, and says:

They (the Transit Commissioners) should have kept careful and incessant watch. The failure of the Transit Commission, holding as it did, the strongest fiduciary relations to the public, to adopt precautionary measures, seems to me, in the light of the evidence presented, to constitute inexcusable neglect on its part. Whether the legislative act creating the commission or the common law itself imposed any obligations upon the gas company with reference to the care of pipes or not, it was the duty of the Transit Commission, it seems to me, to whom the public had a right to look for protection from subway dangers, to guard against such.

I have been unable to learn that there has been any inspection of the pipes and their supports by the Transit Commission or its agents within 24 hours preceding the explosion.

Finally the fire marshal finds that this fire and explosion were not the result of any willful act or omission on the part of any individual or corporation.

Chicago Street Railway Franchises.

Probably the most interesting chapter of the report of the Bureau of Labor Statistics of Illinois, which has just been completed by the secretary, George A. Schilling, is that which gives the results of a very exhaustive inquiry into the history of the organization, development and financing of street railway corporations, dealing chiefly, however, with the three leading Chicago systems, which, by reason of their extent and representative character, "best show how franchises for which the municipality received little or nothing have grown in value with the rapid development of the city and with very little effort on the part of the capitalists, who obtained them for no consideration whatever." The attitude of the bureau on this subject can be understood after noting this quotation, but if any doubt exists as to the position of the compilers it will surely be removed by the following abstract:

The story of the rise and growth of the street railway business of Chicago reads like a romance. Certainly in few other lines have millions multiplied with greater rapidity. On about 700 miles of surface lines that could to-day be duplicated exclusive of the franchises for less than $40,000,000, there has been placed a capitalization of more than twice that amount. On all of this capital, save in the case of some lines most recently constructed, good dividends are regularly declared. The elevated roads have been still more highly capitalized, but being shut out from the down-town district, they have not thus far, in their very short history, earned enough to make their securities worth much, if any, more than the cost of construction of the roads. But with the completion of the Union Loop the coming summer, the prospects point to as great a future for these as for the surface roads, with a corresponding creation of enormous profits for their promoters and directors. This immense capitalization, without a corresponding investment, aptly illustrates to the initiated the unearned increment in such cases, but deceives the general public as to the amount of the exorbitant tribute levied by the owners of city franchises. It has been impossible to get at the actual amount of money invested in these properties, and for that reason the computations here given are based on the most reliable estimates obtainable as the cost of duplication.

The shares of the three leading street railway companies have all sold above par during the past year, and since the panic of 1893, some of them, owing to the exorbitant dividends paid, have sold as high as 340. On the basis of the average price of their securities in 1896 the market value of the three leading street railway systems, which operate 488 miles, is approximately $90,000,000, against a valuation, measured by the cost of duplication, of about $30,000,000. The difference of $60,000,000 represents mainly the growth in the value of these properties since they began operations less that 40 years ago, due to the increase in population of the city of Chicago.

The report presents valuable statistics, in support of the conclusion which it reaches as to the over-capitalization of the properties:

ORIGINAL CAPITALIZATION.

	Incorporated.	Capital stock.
Chicago City Railway company	Feb. 14, 1859	$1,000,000
North Chicago City Railway company	Feb. 14, 1859	1,000,000
Chicago West Division St. Ry. Co.	Feb. 12, 1861	1,500,000
Total		$3,500,000

MILEAGE AND CAPITALIZATION, 1886.

	Miles.	Bonds.	Cap. stk.	Total.
Chicago City Ry. Co.	90	$3,000,000	$3,000,000	$ 6,000,000
*North Chgo. City Ry. Co.	29	1,247,000	500,000	1,747,000
†West Division Ry. Co.	65	4,040,000	1,250,000	5,290,000
Chicago Passenger Ry. Co	32	400,000	1,000,000	1,400,000
Total	216	$8,687,000	$5,750,000	$14,437,000

*Name afterward changed to North Chicago Street Railroad company.

†Afterward absorbs Chicago Passenger Railway company, and name changed to West Chicago Street Railroad company.

MILEAGE AND CAPITALIZATION, 1896.

	Miles.	Capital stock.	Other Obligations.	Total.	Total per mile.
Chi. City Ry. Co.	184.22	$12,000,000	$ 4,619,500	$16,619,500	$ 90,216
W. Chi. St. Ry. Co.	202.62	13,189,000	17,102,900	30,291,900	149.501
N. Chi. St. R. R.	101.	6,600,000	8,180,900	14,780,900	146.346
Total	487.84	$31,789,000	$29,903,300	$61,692,300	$126,460

In explanation it offers the following:

In other words, the capital per mile of track has grown from 1886 to the end of 1896 from $66,838 a mile to $126,255 a mile. In 1882 all the lines were horse cars. Of the 78.3 miles of street occupied, 15.5 miles belonged to the North Chicago Street Railway company, 18.8 miles belonged to the City Railway on the South Side, and 44 miles were possessed by the Chicago West Division railway.

In 1886 only 20 miles were cable—on the South Side—and the remaining 196 miles were horse cars. At the close of 1896 the mileage was as follows:

	Cable.	Electric.	Horse.	Total.
Chicago City Railway	34.92	141.76	7.54	184.22
West Chicago Street Ry.	30.42	165.6	6.6	202.62
North Chicago Street Ry.	17.	83.	1.	101.
Total	82.34	390.36	15.14	487.84

The following tables show the approximate cost, according to the opinion of the bureau's experts, of duplicating the properties of the three leading street railway companies:

MAXIMUM COST OF THE THREE LEADING STREET RAILWAYS OF CHICAGO.

405.5 miles electric and horse car track at $15,000		$6,082,500
82.34 miles cable track at $50,000		4,117,000
390.36 miles overhead construction and feeders at $5,000		1,951,800
Equipment: 877 motor cars at $2,000	$1,754,600	
Equipment: 842 grip cars at $650	547,300	
Equipment: 4,644 other cars at $800	3,715,200	
		6,116,500
Power machinery, 53,200 horse power at $70		3,724,000
Power houses, 53,200 horse power at $20		1,064,000
Storage buildings and shops at $5,000 a mile (487.84) miles		2,439,200
Land		3,368,946
Miscellaneous, at $2,000 a mile		975,680
Tunnels		2,000,000
Total		$31,739,626
Total per mile		$ 65,062

One of the leading railway builders of Chicago informs a representative of the bureau, after a careful examination of each item of the maximum table, that the figures were certainly safe and he believed these three systems could be built to-day for $60,000 a mile.

MINIMUM COST OF THE THREE LEADING STREET RAILWAYS OF CHICAGO.

405.5 miles electric track, at $14,000 per mile	$5,677,000
82.34 miles cable track, $37,500 per mile	3,087,750
390.36 miles overhead construction and feeders, at $4,500 per mile	1,756,620
Equipment as before	6,016,500
Power machinery, 53,200 horse power, $70	3,724,000
Power houses, as before, at $20	1,064,000
Storage buildings, shops, etc., at $4,000	1,951,360
Land	2,526,709
Miscellaneous, at $1,500 per mile	731,760
Tunnels	2,000,000
Total	$28,535,699
Total per mile (487.84 miles)	$ 58,494

It appears that the Chicago City railway can be duplicated for $11,431,160, or $62,052 a mile, although it is capitalized at $16,619,500, or $90,216 per mile, and this capital has a market value of $28,619,500, or $155,355 a mile, and at times has a fourth more value.

The West Side system, which can be duplicated for $13,380,716, or $66,033 per mile, is capitalized at $30,291,900, or $149,500 per mile and its securities have a market value of $36,679,100, or $181,024 per mile.

The North Side system which can apparently be duplicated for $6,927,750, or $68,591 a mile, is capitalized at $14,780,900, or $146,346 per mile, and these securities are worth to-day $24,610,400, or $243,667 per mile.

The subject of taxation is carefully considered from the same point of view, as will be seen from the following abstracts:

At the close of 1896 there was $12,000,000 of stock of the Chicago City Railway company outstanding, but inasmuch as $2,000,000 of this had been issued subsequent to May 31, and was, therefore, not subject to taxation for that year, there is left $10,000,000 as the amount to be considered in determining the proportion of public burdens borne by this corporation. The company paid dividends of 12 per cent. on stock. This would indicate a market value of $240 per share of $100, par value, or $24,000,000 for the whole if the entire amount paid in dividends be capitalized on the basis of five per cent. Five per cent. is assumed as the proper basis by reason of the opportunity for large investment of known and proved stability and because the dividends are net, being made after all taxes and public charges have been paid. That this basis is a conservative one is shown by the fact that these stocks sold, during the year, as high as $300 per share, and never lower than $210. In addition to the stock, the bonds and other obligations of this company amounted to $4,619,500, making a total market value of $28,619,500.

The total equalized valuation, as reported by the State Board of Equalization in their annual report for 1896, was $1,300,000, or 4.54 per cent. of the market value, as against 11.1 per cent., which was the average rate of equalized assessment for property in the central business portion of Chicago.

The commission appointed early in 1896 learned that the average assessment of property in the central business portion of Chicago is about 9.25 per cent. of true value. To this must be added 20 per cent., the amount by which the local assessor's valuation was increased in 1896 by the State Board of Equalization, making a total of 11.1 per cent. of true value. The report continues:

The property of this company is located in three different towns, each having a different tax rate as follows: South Town, 8.344; Hyde Park, 8.464; the Town of Lake, 8.414. Taking the rate for the Town of Lake.

which is slightly above the average, and applying it to the whole, gives $109,382 as the total of the general taxes paid by this corporation for all state, county and municipal purposes. To this must be added $133,703.59, which was, according to Mayor Swift in his last annual message to the City Council, the total of all receipts by the city from the company for the year 1896 for car licenses, electric light, maintenance and all other municipal charges. This gives $243,085.59 as the total of all taxes and public charges paid by the company in any way and for any purpose. This is $24,207.42 less than was paid, for taxes alone, by business property in the central business portion of Chicago representing an equal amount of value. The gross earnings of this company for 1896 were, according to the report of the secretary, Mr. F. R. Greene, $4,808,866. The entire amount, therefore, of all taxes and public charges paid by this company was 5.05 per cent. of the gross receipts.

The West Chicago Street Railroad company at the end of 1896 had stock outstanding to the amount of $13,189,000, par value, on which it paid dividends of six per cent. Capitalizing this on the same basis as in the case of the City Railway company gives $15,826,800 as the market value of the stock. In addition to this there was $624,900, par value, of outstanding stock of the Chicago West Division railway on which dividends of 35 per cent. are guaranteed and which may therefore be reckoned as having a market value of $4,374,300. The other obligations of this road, consisting for the most part of bonds, which on the average sell at par, amount to $16,478,000, making a total of $36,679,000. The total equalized valuation of this property is $1,100,000, or three per cent. of the market value.

The tax rate in the West Town, in which almost all of the property of this company is located, was for 1896, 9.094, which, applied to the equalized assessed value, gives $100,034 as the total amount of taxes paid by this company, which does not appear excessive in view of the fact that an equal amount of value in business property would have been obliged to pay $366,916.71.

In addition to taxes, however, this company paid, in the way of car licenses and other municipal charges, $69,726.87, making a total of $169,760.87, or 4.22 per cent. on the gross earnings of $4 018,948, which covers all public charges of every kind. This means that this company, for all taxes, licenses and public payments, paid $197,155.84 less than a private citizen would have been compelled to pay in taxes alone upon property of equal value.

The North Chicago Street Railroad company has capital stock outstanding to the amount of $6,600,000, par value, upon which dividends of 11.5 were paid. This would indicate a market value of $15,180,000. To this amount must be added $249,900, par value, North Chicago City Railway stock, upon which 30 per cent. dividends are guaranteed, making this stock equivalent to $1,499,400, market value, and $7,931,000 of other obligations, bringing the total securities of this company to $24,610,400. The equalized assessed value was $500,000, or 2.03 per cent. of the true value, as against 11.1 per cent. in the case of the ordinary citizen. The tax rate of the North Town was 8.974, which makes the total tax of this company $44,870 as against $242,939.10 which the business man would have to pay on an equal amount of capital invested in business properties. The total of all other charges paid by this company was $69,739 86, making a total of all payments of $114,609.86, which is $128,329.24 less than the private citizen would be compelled to pay in taxes alone.

The three roads paid, in taxes and all other public charges, $527,456.32, instead of $877,148.82 which they should have paid as taxes alone. In other words, the Chicago roads secure such abnormally low assessments that they save in general taxes, compared even with the low assessed property in the heart of Chicago, far more than they pay in car licenses and all other special taxes aside from paving between the rails and two feet each side.

All taxes and special payments of the three leading roads in 1896 were 4.42 per cent. of the total or gross receipts of $11,941,524. The general taxes were $253,376, or 2.12 per cent. of the gross receipts. The other payments were $273,170.32, or 2.29 per cent. of gross receipts.

A comparative review of the street railway systems of Montreal, Baltimore, Toronto and Detroit is given, and this is followed by tables giving the capital stock of each of the principal Chicago lines, with the dividends and real net earnings for each year since 1891. An interesting comparison is made in the following tables:

	No. lines.	Miles. Horse.	Electric.	Cable.	Dummy.	Total miles.	No. Cars.
Massachusetts	59	88	1,729	....	6	1,823	6,364
Connecticut	23	....	334	..	....	334	923
Illinois	45	74	877	82	27	1,060	6,265

	Capital stock. per mile.	Funded debt.	Total per mile.	Total for all track.
Massachusetts	$31,800	$22,700	$54,500	$60,315,100
Connecticut	28,900	20,000	48,900	16,322,740
Illinois	74,000	60,500	134,500	142,552,955

Commenting on these tables, the report says: At the beginning of 1896 the Illinois roads, with only 58 per cent. of the track and less equipment than the Massachusetts roads, had $142,552,955 capital, 2⅓ times the $60,315,100 capital of the Massachsetts roads. The average capitalization of the latter, including such over-capitalized companies as the West End of Boston, was only $54,500 a mile, while in Illinois the average was $134,500 a mile.

While none of the Chicago roads make sufficiently itemized statements of expenses to enable one to draw many conclusions, a few thing are given in the following table:

	Miles.	Gross earnings.	Gross earnings per mile.	Net earnings before deducting taxes and other public payments.	Net earning per mile.
Chicago City Ry.	184.22	$4,808,866	26,104	$2,074.743 59	$11,263
West Chicago St Railroad	202.62	4,018,948	19,835	1,950,295.87	9.625
North Chicago St Railroad	101.	2.913,710	28,849	1,589.061.86	15,733
Totals and av.	487.84	$ 11,741.524	$23 907	$5.614,101.32	$11,508

	Taxes and other public payments	Taxes, etc., per mile.	Operating expenses, including taxes and other public payments.	Per cent. of operating expenses to gross earnings.	Per cent. taxes to gross earnings.
Chic. City Railway.	$243,085 59	$1,320	$2,734,122.41	56.86	5.05
West Chic. St. R. R.	169,760.87	838	2,068,652.13	51.47	4.22
N. Chic St. R. R.	114,609.86	1,135	1,324,648.14	45.58	3.19
Totals and av.	$527.456.32	$1,081	$6.127.422.68	52.19	4.42

	Per cent. of operating expenses and taxes to gross receipts.	Amount paid by each passenger for operating expenses and taxes.	Per cent. to gross receipts of net earnings left for interest, profit and depreciation.	Amount paid by each passenger for interest, profit and depreciation.
Chicago City Railway	61.91	3.1c	38.09	1.9c
West Chicago Street Railroad	55.69	2.78	44.51	2.22
North Chicago Street Railroad	48.77	2.44	51.23	2.56
Averages for all	56.61	2.53	43.39	2.17c

There are also copious extracts from the message of Gov. Richard J. Oglesby, vetoing the act of 1865, which was intended to extend not only the charters but the city licenses and ordinances relating to the street railways for a period of 99 years, and from numerous court decisions covering legal questions germane to the subject.

Regarding the Act of Legislature of 1865 above referred to, which was passed over Gov. Oglesby's veto, and which the companies still claim is operative, although there is a difference of opinion among lawyers as to its constitutionality, the report raises one interesting point which seems to have escaped attention heretofore:

But whatever may be the constitutionality of the act of 1865, events have occurred since 1883 which render it absolutely useless to the companies because the act of 1865 refers only to horse car lines, as follows:

An act concerning horse railways in the city of Chicago. Section 1. Be it enacted * * * that the first section in an act of said General Assembly, entitled "An act to promote the construction of horse railways in the city of Chicago," approved February 14, 1859, and the first section of a certain other act of said General Assembly, entitled "An act to authorize the extension of horse railways in the city of Chicago," approved February 21, 1861, be and the same are hereby so amended as that all the words in said respective sections after the word "company" therein respectively shall be and read as follows, viz.: "For 99 years with all the powers and authority hereinafter expressed or pertaining to corporations for the purposes mentioned."

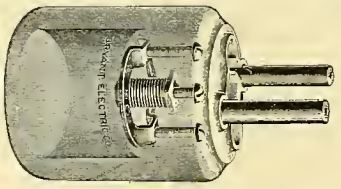
The next section authorizes the Chicago street railway companies then chartered "to construct, maintain and operate a single or double-track railway * * * along such street or streets * * * as the Common Council of said city have authorized said corporations or any of them, or shall from time to time authorize said corporations or either of them so to do in such manner and upon such terms and conditions * * * as the said Common Council has or may, by contract with said parties or any or either of them, prescribe; * * * and all contracts, stipulations, licenses and undertakings" between any of the companies and the Common Council were to continue in force during the next 99 years.

The ordinances of the Chicago City Council thus referred to granted the use of the streets to the street railway companies with the express stipulation that the "cars to be used upon said tracks shall be operated with animal power only."

Now there are scarcely any horse railways left in the city, and the act of 1865 certainly did not extend the scope of the ordinances of the city of Chicago to the kind of track to be used, but only as to the extent of time of the existing horse-car ordinances. There is no warrant whatever in the act of 1865 for any extension of the city ordinances for electric and cable lines which did not at that time exist anywhere in the world. Subsequently when the city of Chicago did permit the use of mechanical traction, such permission was accompanied in every case with either no extension of the life of the franchise or only 20 years at the most. When the franchises for the city run out, therefore, in 1903, the companies have no legal right to the streets. * * * The only alternative to the loss of rights in the streets in 1903 would seem to be for the companies to go back to horse cars.

Weatherproof Socket.

The cut shows the new weatherproof socket made by the Bryant Electric company of Bridgeport, Conn., known as No. 1104. The particular advantages

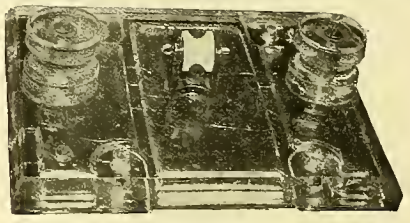


WEATHERPROOF SOCKET.

claimed over other sockets lie in the method of sealing in the wires, which is claimed to make it absolutely weatherproof, and the length of the porcelain skirt at the bottom, which is unusually great, fully covering the lamp base. This style of socket is made for Thomson-Houston and Westinghouse bases.

Glass Hangerboard.

W. B. McDonald, well known to Chicago electrical men as the superintendent of the People's Electric Light & Motor Power company, has devised a glass hangerboard for arc lamps, which is handled by the Metropolitan Electric company of this city. As may be judged

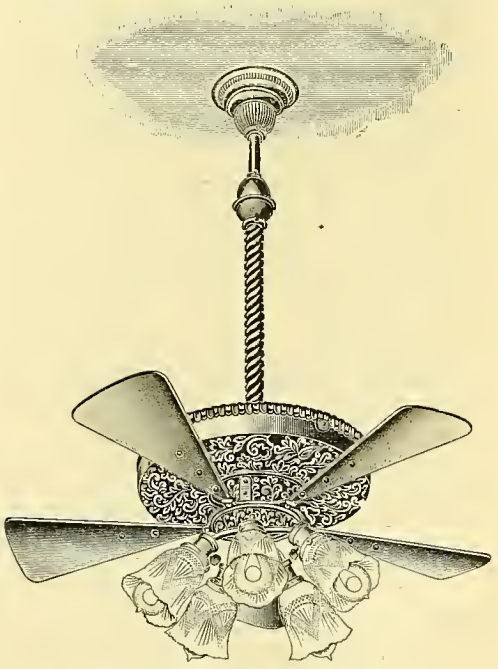


GLASS HANGERBOARD.

by the picture, the distinguishing feature is the employment of glass. A row of holes in the glass permits the insulators supporting the wire to the lamps to be removable. The advantages over slate and wooden hangerboards are thought to be obvious.

Twentieth Century Ceiling Fan.

The latest type of electric ceiling fan made by the Emerson Electric Manufacturing company of St. Louis,



TWENTIETH CENTURY CEILING FAN.

for high alternation circuits, is shown in the cut. It is designed to be operated at from 500 to 600 revolutions per minute, and has five aluminum blades of 30 inches sweep. The motor is direct-connected, of course, and the power consumed is placed at 100 watts. The company has decided to withdraw its two-bladed fan, believing that the new type will supersede the older one altogether. Of the Twentieth Century fan the company

says: "It is a wonderful air agitator, and when deflected from a table, bar or the floor the breeze is felt in all parts of a good-sized room. It runs quietly, and by its speed forces a heavy and steady volume of air in circulation, and keep it circulating."

Porcelain Ceiling Board and Arc Cut-out.

The accompanying cuts illustrate two important adjuncts for use with arc lamps: the arc ceiling board, Fig.

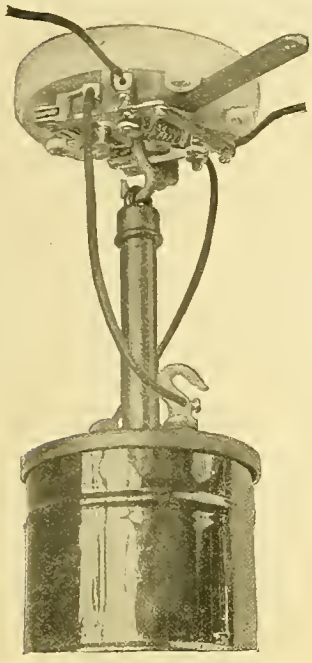


FIG. 1. PORCELAIN CEILING BOARD AND ARC CUT-OUT.

1, and the arc cut-out, Fig. 2. Early practice allowed the use of wood in the construction of these appliances, but experience has shown the wisdom of making them entirely of incombustible material.

The bases are made of best quality of glazed porcelain. Cast brass is used for connection parts. The lamp is suspended from a hook in the ceiling board and the lamp leads are attached to easily accessible connectors in the manner shown. The arc cut-out is a substantially built, quick break, double-pole, double-throw switch, making an absolute cut-out on both sides the lamp circuit. A cam and spring action make it impossible to hold the switch at any intermediate point between "on"

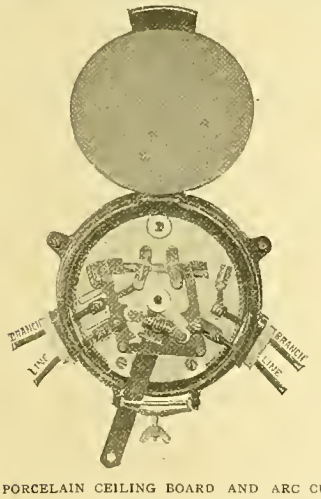


FIG. 2. PORCELAIN CEILING BOARD AND ARC CUT-OUT.

and "off," so that the current is never opened on the line.

This cut-out may be used as a ceiling board, in which case a hook for hanging the lamp is attached to its center, or it may be placed in an iron box (the hook being removed) for use out of doors. Letters cast on the box cover indicate the "on" and "off" positions of the switch. These useful and reliable appliances are made by the General Electric company of Schenectady, N. Y.

The Coles County Telephone company of Mattoon, Ill., has been incorporated with a capital stock of $12,000 to operate a telephone exchange. The incorporators are I. A. Lumpkin, W. C. Lumpkin and John W. Gay.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

John Williams and Ole Barnstad have applied for a franchise for a local telephone exchange at Willmar, Minn.

W. R. Hind and others have been granted a telephone franchise at Fairfield, Iowa, and 80 subscribers have been secured already.

The Wisconsin Telephone company's exchange at Oshkosh, Wis., was damaged by fire, with a loss of $1,000 to $1,200. The origin of the fire is a mystery. The company made a great rush on repairs, and in 48 hours had 400 instruments in order.

The Home Telephone company of Marshalltown, Iowa, has nearly 400 subscribers.

A telephone line is projected to Ellensburg, Wash., from Thorp.

The Sheboygan & Manitowoc County Telephone company of Kiel, Wis., will begin construction on its lines to Elkhart Lake, Rhine, Franklin, Mission House College and St. Nazianz.

The Iowa Telephone company will put in an exchange at Newton, Iowa.

The Rushford Telephone company has begun work on a line from Rushford, Minn., to connect with Preston and Canton, Winona, Rochester, Decorah and La Crosse.

Work is begun on the Harmony, Minn., telephone exchange.

A telephone line between Strahan and Hastings, Iowa, has been begun.

The Union Telephone company has collected materials preparatory to building from Union, Ore., to Cornucopia, Baker City, and other Eastern Oregon points.

Wm. L. Morse, formerly superintendent of the Duluth-Superior Telephone company, at Superior, Wis., pleaded guilty to embezzling $350 of the company's funds and asked the clemency of the court. He was sentenced to six months' imprisonment.

The Cedar Valley Telephone company has begun installing its instruments at Grundy Center, Iowa.

The E. H. Martin Telephone company has made a proposition to put in a telephone exchange at Eagle Grove, Iowa.

The Cedar Rapids & Marion Telephone company has materials distributed for its line to Lisbon and Mt. Vernon, Iowa. Connection will be made later with Tama City.

Elroy, Wis., now has telephone connection with Mauston via Hustler and New Lisbon.

Patent Office Announcements.

Commissioner Butterworth on assuming office announced several important changes in the methods employed in the Patent Office, and called attention to other rules that will hereafter be strictly enforced. One of the first acts of his administration was the promulgation of the following amendment to the Rules of Practice:

Rule 28 of the Rules of Practice, edition of February 9, 1897, is repealed, and the following is substituted therefor: 28. If an amendment to an application be presented more than six months after any action therein, of which notice shall have been given to the applicant, it may not be admitted, except upon a showing duly verified of good and sufficient reason why it was not earlier presented.

Persons who are not employes of the office may, under the supervision and direction of the librarian, make extracts, in pencil, from descriptions and drawings contained in the Scientific Library, such extracts, when in the nature of copies, not to exceed one-third of the descriptions or drawings from which the copies are made. Violation of this order will subject all persons and parties concerned in the violation to exclusion from thereafter making any such extracts or copies whatever.

Attention is called to the fact that before any person will be recognized as an attorney his special power of attorney in each case must be filed, and thereafter the correspondence will be held with him alone. It is also directed that any person who has been disbarred from practice before the Patent Office by order of the commissioner be denied access to the files of the office, either in his own capacity or as the representative of any other person or firm.

Oaths accompanying applications for patents made within the following-named foreign countries must be taken before a minister, charge d'affaires, consul, or commercial agent holding commission under the Government of the United States: Austria-Hungary, Argentine Republic, Belgium, Brazil, Costa Rica, Denmark, Haiti, Honduras, Italy, Mexico, Netherlands, Norway, Peru, Portugal, Russia, San Salvador, Servia, Sweden and Switzerland. Notice is given that applications filed in the Patent Office presenting oaths not executed in compliance with the order will be treated as incomplete.

After the notice of allowance of an application is given, a case cannot be withdrawn from issue on account of any mistake or change of purpose of the applicant or of his attorney, nor for the purpose of enabling the inventor to procure a foreign patent, nor in any other case, without the approval of the commissioner.

The Patent Office is always pleased to receive from manufacturers and publishers such catalogues, circulars, price-lists, or other advertisements relating to the sciences and mechanical arts as are published by them for gratuitous distribution. Not less than three copies should be forwarded in order that the subjects may be properly indexed, classified, and sub-classified in the Scientific Library for reference.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 8.—The absurd report that the "Keely motor" is to be used on the Manhattan elevated railroad system is, of course, denied by General Manager Fransioli, Mr. Fransioli recently visited the Keely shops in Philadelphia, and it would seem that the report grew out of this visit. "I did not go to Philadelphia," he explained, "as a representative of the Manhattan Railroad company, but simply as a private individual. I was one of a party of guests invited to see the motor, and as I am always interested in anything appertaining to motive power, I accepted the invitation and saw the invention." Several inquiries were put to Mr. Fransioli as to the source of the power employed by Mr. Keely; but apparently he was as much in the dark regarding it as other people. "I saw the motor," said Mr. Fransioli, "and I saw it put in motion, but what was the power used I cannot attempt to explain; nor am I able to give any opinion as to its probable commercial value."

The Board of State Railroad Commissioners heard further arguments on Wednesday against the application of the Metropolitan Street Railway company for permission to change the motive power on its line in Madison avenue from horse to electricity. William H. Page, Jr., opposed the motion on behalf of the companies operating the Third avenue and Forty-second street, St. Nicholas avenue and Manhattanville lines. W. C. Trull appeared for a Madison avenue property owner against the application, and John Harsen Rhoades, who at a previous hearing presented the objections of a number of Madison avenue residents, was present and gave further reasons for opposing the change.

Residents and property owners along the boulevard were invited to an open consultation with the Rapid Transit commissioners on Thursday afternoon, to have explained to them the plans of the board for the construction of the rapid transit road along the boulevard and to make suggestions on their own part. After some discussion it was decided that Messrs. Romaine and Jencks, representative property owners, should send out invitations for a meeting of property owners along Broadway and the boulevard from Forty-second street to 194th street, to be held within a week.

The New York & Sea Beach Railroad company has secured an injunction from Justice Maddox in the Supreme Court in Brooklyn restraining the Coney Island & Gravesend Electric Railway company from constructing its road on West Eighth street, Coney Island. The injunction was served upon Contractor Charles Hart, Jr., and Engineer B. B. Legare, who immediately stopped work. Lawyer T. Ellett Hodgskin also obtained an order requiring the Nassau Electric Railroad company to show cause why its officers should not be punished for contempt of court for ignoring an injunction granted to restrain the company from laying tracks on Surf avenue, Coney Island, on property claimed by the New York & Sea Beach company. M. S.

From Old Virginia.

RICHMOND, May 8.—At a recent meeting of the Valley Telephone company at Harrisburg, the stockholders decided to reduce the rates of telephones for business houses from $25 per year to $15, and for residences from $15 to $10 per year. They also appointed a committee to confer with a similar committee to be appointed by the Mutual Telephone company to ascertain whether any

combination of interests can be effected. The Valley company operates about 200 instruments while the Mutual has 100 on its several lines.

The Staunton Street Car company is so well pleased with the working of the 2½ cent rate that it is announced that no return to the five cent rate will be made.

The Manchester City Council had an exciting meeting when the street railway muddle came up for consideration. There is a decided difference of opinion between the council and the Richmond Railway & Electric company over the paving of Hull street. The proposition of the company was identical with its former one, except that girder rails would be laid down in some places instead of flat rails. One of the members expressed the opinion that the proposition had better be accepted, as the city was bound to refund the company's taxes anyway. This was not done, and temporary adjournment was had that a committee might confer with the company. When the council reconvened the committeemen reported that they had made a proposition to Capt. Pazzini that they would pay the taxes and the city would pay one-half of the expense of paving the street, but that this offer had been refused. A resolution that the paving be proceeded with and that the company be not compelled to imbed the rails in concrete, but be allowed to use broken stone was lost. A committee was finally appointed to consult further with the company looking toward some final agreement.

The Pulaski Electric company of Pulaski, Va., which was organized recently, will apply for a franchise, and, if it is granted, will erect a plant.

A charter has been granted to the Staunton Telephone company. The capital stock is $15,000. William Patrick is president and Newton C. Watts secretary and treasurer. The company will operate the exchanges now established at Staunton, Lexington and the one under construction at Clifton Forge. Y. P.

Denver, Colo.

DENVER, May 6.—Electric lights were turned on for the first time in Hardin's addition to Canon City, Colo., on April 17th.

A telegram from Grant, a small station on the line of the South Park road, announces that a great reservoir and electrical power plant is under consideration for that mining region. Engineer Cunningham, who has charge of the work, is going to London, England, to meet the capitalists who are putting money into the enterprise. The reservoir is to be located in Geneva canon below the foot of Kenosha hill. The project is one of the largest that has yet been seriously considered in connection with the South Park region. It is known that the ground has been carefully examined, and reports have been submitted by some of the most eminent electrical and irrigation experts of the country. The filings upon the government land were made so quietly that no intelligence reached the ears of the public at the time. One of the features of the project is the construction of electrical tramways leading from the principal mining districts of the region to Grant and Webster, connecting with the South Park road, thereby affording an easy shipment of ores to the Denver smelters. It is proposed to run one of the trams via the old tunnel of the Geneva mine, situated at the head of Geneva gulch, to the camps of Rathburn, Montezuma, Middle Swan and if possible to Breckenridge and to other camps of Summit county. The country is said to be dotted with deserted camps whose log cabins have not resounded to the sound of a human voice for a quarter of a century. This state of affairs was brought about by the crude transportation facilities heretofore afforded the district. The Geneva tunnel is now in the mountain 1,300 feet, and it is claimed that an extension of 250 feet will put the tunnel through one of the highest peaks of the main range and would practically be the means of saving a haul of 20 or 30 miles over Boreas pass from the camps of the western slope. The idea is one which will require practical engineers to work out, but if the tunnel can be utilized several paying mining districts now shut out of the world will be brought into communication with the smelters of Denver. The rough haul over the mountains at present forbids shipments from the abandoned camps.

The Electric Power & Ore Transportation company is the style of a new company organized recently at Breckenridge, Colo. The object of the company is to use water power taken from the numerous streams in the vicinity of Breckenridge for the purpose of generating electricity to be used as power for mills and for an ore tramway also for lighting purposes. The backers of the enterprise are expected from the East before the first of June to arrange for active operations.

It is reported on good authority that a new company to furnish electric lights and power to the city of Denver and adjoining towns is now being formed. The men interested in the enterprise are among the most influential and wealthy in the state, and just as soon as they get their plans arranged they will ask for a franchise. The names of the 10 men interested in the enterprise are withheld for the present. D. B.

Northwestern Notations.

MINNEAPOLIS, May 8.—Graceville, Minn., has been surveyed for an electric light plant, and a 600 light system will be installed.

The Beloit Water Power company of Beloit, Wis., is considering a project for concentrating the 40 flumes into one big one, with 10 turbine wheels, and developing electricity. An increase of 50 per cent. in power is expected. The cost of the change and new machinery would be $75,000.

An ordinance has been offered in the Minneapolis City Council providing for a five per cent. tax on the gross receipts of electric light companies doing business in Minneapolis.

Will Law has become manager of the Oskaloosa, Ia., Electric Light company.

Holders of second-mortgage bonds of the Gas & Electric company in St. Cloud, Minn., are taking testimony to sustain the point that the improvements and additions to the plant, made since the first-mortgage bonds were issued, are not covered by those bonds and should not be included in the mortgage sale.

The Iowa Legislature has defeated the Indiana telegraph taxation system.

Kramer & Bergman Bros. have bought the electric light plant at McGregor, Iowa, and will remove the station to higher ground and rebuild the system.

Valley City, N. D., voted bonds for an electric light plant.

The electric light plant of Beresford, S. D., was sold to L. N. Crill and Wm. A. Field of Richland and Louis Wagner of Lennox, S. D. They will put the plant in shape for active operations.

Shenandoah, Iowa, is in darkness because the council cannot agree with the electric light company on a price for electric lighting.

Hancock, Mich., awarded the contract for an electric light plant to the Fort Wayne Electric corporation for $6,300, and for the steam plant to the Buckeye Engine company for $3,400. The village will vote on bonds some time this month.

Foster D. Vannam has been appointed electric wire inspector in St. Paul. He has been foreman of the Claussen-Bonwell Electric company for the last four years.

The Eau Claire Light & Power company is the name of the reorganized company at Eau Claire, Wis., and it will expend $20,000 in new machinery.

The Citizens' Traction company of Oshkosh, Wis., has begun tracklaying. The mayor required a bond to guarantee that the streets should not be left torn up.

The North American Telegraph company has moved its head office in Minneapolis into new quarters, at No. 12 Fourth street south. The changes in wiring were effected without interfering with the general business of the company. The ground floor is occupied by the general business offices, the second floor by the directors, clerks and heads of departments and the third floor has the operating room, where some 50 operators are employed. The company has been in existence 11 years, and its business has increased constantly.

The St. Paul Board of Aldermen has passed an ordinance requiring the Interurban & Como avenue cars to run down Fifth street to Broadway and up Broadway and Seventh streets to Wabasha, instead of running around the Robert street loop.

J. T. Duffy & Co. offer to put in an electric light plant and furnish light and heat for the courthouse and city hall in St. Paul for $26,000 per year for three years, and $500 less each year for the next six years, the plant to be turned over to the city at the end of that time.

Jos. Underleak was granted a franchise for electric lighting at Chatfield, Minn.

Patrick K. Mann, a lineman for the Wisconsin Telephone company at La Crosse, Wis., fell from a pole and fractured his skull, death resulting in three hours.

The Northwestern Electrical association will meet in La Crosse, Wis., in July. The street railway company there is arranging a representation of a ship in which to give the visitors a ride over its lines.

A mass meeting at Grand Forks, N. D., requested the Council to secure an electrical expert to estimate the cost of an electric lighting plant for the city.

E. W. Swanson, the ex-manager of Western Union at Litchfield, Minn., has sued the company, Superintendent McMichael and Folgatter & Co., a Minneapolis grain firm, for $10,000 damages. Swanson conducted a grain commission business in connection with the telegraph business, of which the company was aware. Before his dismissal he purchased for his customers through Folgatter & Co. options for several thousand bushels of wheat, and he claims that the understanding was that the deals should be closed when the margins were exhausted. There was a break in the price and Folgatter & Co. claimed to have closed out at a loss of $150 below the margins, which sum they wanted Swanson to make good. He refused, as it was contrary to the agreement, and it would have to come out of his own pocket. Folgatter & Co. then complained to the Western Union company, whose superintendent notified Swanson that if he did not pay the amount he would be discharged. On his refusal to pay a man was sent to take his place. Being thus discharged he claims it is impossible for him to get work with other companies.

The Redfield, S. D., artesian well is 800 feet deep and the first flow of water has been struck. It will be sunk another hundred feet and the electric light plant operated by the well when it is completed.

The Mellen Water & Light company of Mellen, Wis., has been incorporated with $5,000 capital stock.

The Quinnesec Falls company is preparing to make a large addition to its electric power plant at Quinnesec Falls, Mich., which will make it the largest between Niagara and Minneapolis.

H. W. Winslow has purchased materials in Chicago for an electric light plant to be in operation in Rockford, Iowa, by June 1st. C.

PERSONAL.

Morris W. Mead of Pittsburg was a Chicago visitor last week.

E. Rosewater of Omaha, Neb., is in Chicago visiting some of his old friends in the electrical business.

Alexander Dow of Detroit was in Chicago last week to begin work on the test he is making on the West Side park lighting system.

Louis K. Comstock of Chicago, the electrical engineer and contractor, who has been confined to his home by a severe attack of the grip, is reported to be recovering.

John S. Seymour, recently United States commissioner of patents, will open an office in New York and will continue the practice of patent law, and his partner will be a brother of former Attorney-general Harmon.

The late Merritt C. Bristol, who was superintendent of construction for the Western Union Telegraph company at Chicago, left $12,000, according to letters of administration that have been issued on his estate in the Probate Court. Mary J. Bristol, the widow, was appointed administratrix. Three minor children are the other heirs.

Frank W. Hawley, the Niagara Falls promoter, is in California, and it is said that he is making estimates for running the Shasta division of the Southern Pacific railroad by electricity. The grades are heavy on this line, and the operating expenses are large. The Sacramento River and its upper tributaries could be made to furnish power to move all trains at comparatively small cost, it is claimed by Mr. Hawley.

The following-named were among the out-of-town visitors registered at the headquarters of the National Electric Light association last week: M. E. Baird, Windsor, Conn.; W. E. Sharps, J. L. Fannon, H. T. Paiste and H. B. Cutter, Philadelphia, Pa.; F. O. Briggs, Trenton, N. J.; David Bloch, City of Mexico; L. B. Stillwell, Pittsburg, Pa.; F. W. Darlington, Philadelphia, Pa.; Mr. Mooney, Poughkeepsie, N. Y.

The announcement of the death of Chauncey Morton Spaulding on May 10th recalls the fact that Mr. Spaulding was for several years prominently engaged in electrical pursuits. He came to Chicago from Benton Harbor in 1885, and was connected with the Western Edison Light company and the United Edison Manufacturing company. He afterward was connected with the Electrical Supply company under F. S. Terry's management, and remained with that company and its successor, the Ansonia Electric company, until the failure of the latter. About three years ago he took a government position as deputy revenue collector, and held that position up to the time of his death.

E. H. Allen, the recent representative of the Sawyer-Man Electric company in Chicago, has resigned his position and has been succeeded by C. A. Ross, formerly the agent of the company at Kansas City. Mr. Ross' territory will include all of the Central West, with headquarters at 171 La Salle street, Chicago. Mr. Ross is an experienced electrical man of wide acquaintance. For several years he was in charge of the Thomson-

Houston and General Electric office in Kansas City. As far back as 1881 he installed an arc lighting plant in Phœnix, Arizona, and this was one of the pioneer plants of the country. For the last year or so Mr. Ross has been connected with the Sawyer-Man company.

From far off Australia comes the pleasing assurance that American enterprise and American wares are regarded favorably by the best authorities in that part of the world. W. M. L'Etrange of the Brisbane Electrical Supply company of Brisbane, Queensland, who is now visiting in this country, speaks flatteringly of American electrical machinery especially. Mr. L'Etrange, while in Chicago last week, said that the prospect of business improvement in Australia was good and that American companies would find the people of that section anxious to trade with them. The object of Mr. L'Etrange's present trip is to inspect the principal work in electrical transmission, light and railway in this country and to study American methods and become thoroughly familiar with American practice.

C. H. Wilmerding has decided to sever his connection with the Chicago Edison company and to open an office in this city as designing, constructing, supervising and consulting engineer, more particularly with reference to the planning, remodeling and complete installation of central station and isolated electric lighting, railway and transmission plants, and the underground distribution of electric currents, and embracing also the supervision, in an advisory capacity, of the operating of existing plants with a view to improved economy and greater efficiency. Mr. Wilmerding's experience has been gained as general manager for five years of the Chicago Arc Light & Power company, general superintendent for the last four years of the Chicago Edison company and president for the last eight or nine years of the Chicago Sectional Electric Underground company, and in various civil, mechanical and electrical engineering undertakings prior to his association with these companies. Mr. Wilmerding's standing in the electrical fraternity has been shown on many occasions when he has been honored by his associates. He has served a term as president of the National Electric Light association, and has filled other positions in that organization. It is also reported that Mr. Wilmerding will be interested in a new fire alarm company now being formed in Chicago.

ELECTRIC LIGHTING.

Sealed proposals will be received at the office of Robert Newton of Benwood, W. Va., until noon on Thursday, May 20th, for furnishing all the labor and materials for the erection of two 125 horse power boilers, two 150 horse power engines one, 60 light 2,000 candle power arc dynamo, one 75 kilowatt alternating current incandescent dynamo, arc lamps, converters, pole line, etc., for an electric light plant for the Benwood & McMechen Electric Light, Heat & Power company, in accordance with the plans and specifications on file with the electric light committee at Benwood, W. Va. Mr. Newton will furnish further information on application.

The plant of the Mutual Electric Light & Power company of Brainard on the Rock Island road, south of Chicago, was sold at auction under a decree of foreclosure on May 7th. Frank H. Decke, representing, it is supposed, the first-mortgage bondholders, bid in the property at $118,258. The plant was built five years ago, and three years later was placed in the hands of R. W. Burns as receiver. About $200,000 has been invested in the concern, which has lines of wire supplying the territory about Englewood and South Englewood. The future disposition of the properly has not been determined.

ELECTRIC RAILWAYS.

A project is on foot in Niagara Falls South, Ont., to build a new trolley line from Victoria Park up through "Jolly Cut" into the village above mentioned, also to the famous Lundy's Lane battle-ground. At present a horse-car line is operated in the village, and if the controlling company will equip the line with electricity within 60 days, the new company offers to abandon the effort to secure a franchise. The trustees of the village have granted the franchise so far as it is in their power. Should this line be built, it will allow of connection with the cars of the Niagara Falls Park & River railway running to Niagara Falls, Ont., and thus give the residents of Niagara Falls South, Ont., much better service in reaching the bridges leading to the New York state side of the river.

There is talk of a possible purchase of a controlling interest in Alley "L" by the Chicago City Railway company. In the hands of the City Railway it is contended that the South Side "L" could be turned into a big dividend earner much more easily than in any other way. It is explained that the Alley "L" needs feeders. The crosstown electric lines of the City Railway company would serve excellently as such by the use of a transfer system. Many millions would have to be expended by the Alley "L" company if it furnished itself with a system of feeders even less perfect than the City Railway crosstown lines already built would provide. It is said that prominent City Railway stockholders are considering and discussing a purchase of a majority of the Alley "L" shares.

Judge Horton has issued an injunction against the Chicago & Northwestern Railroad company restraining it from interfering with the Chicago North Shore Street Railway company in placing a crossing at Central street, North Evanston, just north of the station of the defendant company. On May 12, 1896, the electric company obtained an ordinance from the city of Evanston. The ordinance provides that the road shall be completed within one year. The complainant company made a number of attempts to make a crossing over the tracks on previous occasions but avers that force has been used by the railroad company to prevent the crossing being put in. However, backed by the injunction, the street railway company succeeded in laying the crossing tracks on the night of May 7th.

Master in Chancery Henry W. Bishop filed his report of claims against the Englewood & Chicago Electric Street Railway company in the federal court May 6th. The total amount of the claims is $1,539,033. Of this amount $226,075 is for material furnished. Of the balance $1,050,957 is bond claims, and $262,000 is the judgment debt for money advanced by Stephen D. Bayer of New York. Of the bond claims the reorganization committee claims $650,000, and files objections to the payment of all the other bonds. These, it is alleged, were issued from time to time by Col. W. V. Jacobs and the promoters who got the road from Jacobs and sold it to the Rice syndicate. These claims, over which there will be a sharp legal fight, are: Col. William V. Jacobs, $175,000; Calumet Electric Railway company, $50,000; ex-President John C. Shaffer, $48,000; Frederick W. Short, $8,000; James P. Mallette, $25,000; Edward F. Cragin, $24,380; Alexander Balfour, $22,500; Henry Lewis & Co., $48,377.15.

At the annual meeting of the Calumet Electric Railway company last week no business outside of the election of a new set of directors was transacted. John C. McKeon, as receiver for the Illinois National Bank, and also receiver for the road, voted the 4,400 out of a total of 5,000, which are owned by the bank under the decree recently entered by Judge Showalter. Directors John C. McKeon, George E. Adams and John Farson were re-elected and Charles R. Corwith and E. A. Frost were elected directors to fill the places of George C. Prussing and James R. Mann. Charles R. Corwith, one of the new directors, is a director of the National Bank of Illinois and E. A. Frost is an employe of the receiver of the institution. John Farson was re-elected president of the company and Charles R. Corwith was made vice-president. H. B. White was retained as secretary and treasurer. The road being in the hands of Mr. McKeon as receiver, he has absolute control of it, but it was considered advisable to keep up the organization.

Steam and electricity are fighting a battle for supremacy as a Chicago daily puts it, between Aurora and Geneva, Ill., the principals to the encounter being an electric line and the Chicago & Northwestern Railroad company. Late last fall the electric line was formally opened with an hourly service in both directions between these two towns, the line passing through Batavia and other villages between the two terminals. The Northwestern also has a line between the two points, and it soon discovered that its trains were running practically empty because its service was not as good as that of the electric line. On April 25th it met the competition by inaugurating an hourly service in both directions between the two towns and by placing its fares on almost the same basis as those of the electric line. Trip transportation costs from five to 15 cents, according to the size of the commutation ticket purchased. Fares on the electric line are on practically the same basis. Northwestern officials at the general offices in Chicago indicate that the feeling between the transportation companies is not the most friendly and that the fight may be a bitter one.

It is stated that the General Electric Railway company's trolley conduit scheme in Chicago, about which considerable doubt has been expressed, will be pushed to completion. These details are furnished: "Sewer connections have been made in Wabash avenue and Dearborn street preparatory to the laying of conduits in which the electrical power will be transmitted. The scheme has been financed and contracts for much of the work have been drawn up. The conduits will be put in and the track laid by the Love Traction company and the electrical apparatus and equipment furnished by the General Electric company of New York. As soon as the Supreme Court decision with reference to the validity of the franchises is handed down the anticipation being that the opinion will be favorable to the company—it is proposed to begin building the power house. The promoters are now amply provided with funds, $380,000 already having been advanced through J. P. Morgan & Co. Mr. Morgan, who is a director of the General Electric company of New York, is personally interested in the new Chicago street railway. Albert G. Wheeler is the active head of the enterprise in this city and represents the Love Traction company. The company has secured protection under the Humphrey bills, although the measures originally introduced in the Senate excluded the enterprise."

TELEGRAPH.

Rush Taggart of New York, solicitor for the Western Union Telegraph company, in the United States Court at Omaha on May 3d, asked for leave to make supplementary filings in the case of the United States against his company and the Union Pacific Railroad company in the matter of separating the telegraph business of the defendants. The question before the court is the entering of a decree, in obedience to the mandate of the United States Supreme Court, divorcing the Western Union from the Union Pacific and compelling the latter to operate a telegraph line of its own for commercial purposes. The court took the matter into consideration. It is the conjecture that the defendants are seeking only for time, hoping to defer the entering of the decree until after the contemplated sale of the Union Pacific, when possibly the necessity of the decree may be avoided by the ratification of the old contract by the new company and the making of a new contract.

MISCELLANEOUS.

The supervising architect of the Treasury Department will receive proposals until 2 P. M., May 19th, for the labor, materials, and erection complete, of an electric passenger elevator for the United States courthouse and postoffice building at Topeka, Kan., in accordance with drawings and specifications which may be procured either from the above officer, or from the custodian at Topeka, Kan.

TRADE NEWS.

Huebel & Manger, Brooklyn, N. Y., have again taken additional space, so as to make room for more machinery and a larger force. They are spreading out to keep pace with a growing business. The double window spring which they have lately placed on the market is creating a large demand for itself, and the other goods of their manufacture continue to have a steady sale.

M. M. Whipple, assistant general manager of the American Machine & Tool company of Boston, Mass., is making his usual trip through the central and western states, and will visit all of the leading cities in those districts. He reports that he has closed quite a large amount of business, which has been awaiting a better condition of affairs, and that the future looks exceedingly bright for a business much in excess of that done last year.

The D. A. Kusel Telephone Manufacturing company of 1105 Pine street, St. Louis, reports business to be very good. On one day last week the company filled good orders from Wisconsin and Texas, as well as several from near-by territory. The Wisconsin customer states that there is not a telephone instrument in his county. The D. A. Kusel company's patrons are now found from New Hampshire to California and from Northern Wisconsin to Southern Mississippi.

Catalogue No. 28 of the Murray Iron Works company of Burlington, Iowa, showing the Sioux Corliss engines, is handsome, well arranged and creditable in every way. The company makes simple, compound and condensing, horizontal and vertical engines, as well as tubular boilers for all pressures. The catalogue shows the new features of the engines, gives "seven good reasons why you should buy our Corliss engine," and in mechanical execution its 72 pages leave nothing to be desired.

"Canal Irrigation in Mexico" is the subject of one of the leading articles in the *Engineering Magazine* for May, contributed by C. P. MacKie. It gives valuable information in regard to the conditions upon which such work as this has to be executed, and being profusely illustrated, it conveys to the reader an idea of the great progress which has been attained in Mexico during the last few years in the engineering of such projects. Mr. MacKie is well known in the electrical fraternity as an electrical engineer, being at present electrical expert of the Manhattan General Construction company of New York.

BUSINESS.

The Chicago Telephone Supply company, 118–120 Quincy street, has trebled its space and reports a great increase in business.

The J. W. Ruger Manufacturing company of Buffalo issues a well made catalogue of gas engines. The new engine is styled the Fenner, after its designer, and is said to combine all the qualities necessary to make it attractive and popular.

Sales Agent Porter of the Triumph Electric company of Cincinnati, Ohio, is kept busy looking after agents and assisting in sales. The company is doing an excellent business, reporting a fine list of sales for April. Judging from present indications, the May sales will at least equal those of April.

The Campbell & Zell Co., among recent orders, has just received a contract from the Metropolitan Railway company of Washington, D. C., for 1,204 horsepower of Zell improved water-tube safety boilers, this making a fifth order from that company and aggregating nearly 3,000 horsepower of Zell boilers now in use by it at its several power houses in Washington.

Mr. Locke's catalogue of line insulating materials for high potentials, brought down to date, is a trade list of reliable goods. The two-part insulator is designed for potentials up to 50,000 volts, and it is said that practical tests show that 100,000 volts will not puncture it. Other insulators, pins, brackets, cross-arms, etc., are shown. The pamphlet may be obtained of Fred M. Locke, Victor, N. Y.

The Phœnix Automatic Filter company of Racine, Wis., has made arrangements whereby the well-known Tracy patent oil filters, which it manufactures exclusively, can be obtained from the following-named well-known supply houses: Manning, Maxwell & Moore, 111 Liberty street, New York; Brown Bros. company, Providence, R. I.; Reuter & Mallory, Baltimore, Md.; National Oil Works & Mill Supply company, New Orleans, La.; N. O. Nelson Manufacturing company, St. Louis; Bradford Belting company, Cincinnati; George T. Clarkson company, Pittsburg, Pa.; Central Electric company, Chicago; Chicago Engineer Supply company;

Hendrie & Boltboff Manufacturing company, Denver, Col.; Abner Doble company, San Francisco, Cal.

A satisfactory coloring for incandescent lamps has been long sought. Some lamp colors on the market are not satisfactory, as they give a poor imitation of genuine colored glass. The Electric Appliance company is placing on the market a new coloring, known as electrical chemical lamp coloring, which, it is claimed, colors the lamps in such a way that it is difficult to detect them from genuine colored glass lamps. An examination of the work done with this coloring shows that it is a superior article.

The American Engine company of Bound Brook, N. J., has just begun the shipment of new direct-connected generating plants, in which the American-Ball engine is combined with the new line of six pole generators. The company is now installing a 75 kilowatt plant at 7 East Seventeenth street, New York, in the building of Deitsch Brothers, and a 35 kilowatt plant in the building of the *Evening Wisconsin* of Milwaukee. In addition to this it has orders from the Philadelphia *Enquirer* for a 100 kilowatt plant; the Buffalo *Evening News* for a 35 kilowatt plant; the Phelps Publishing company of Springfield, Mass., for two 35 kilowatt plants; the New York *Tribune* for a 75 kilowatt plant; and the World's Dispensary Medical association of Buffalo for a 25 kilowatt plant.

Orders recently received by the Ridgway, Pa., Dynamo & Engine company for McEwen engines and the new Thompson-Ryan dynamos are as follows: One 12 by 23 by 18 inch compound condensing engine for Ithaca Street Railway company, Ithaca, N. Y. (second order); one 8 by 10 inch automatic engine, direct-connected to a 25 kilowatt Thompson-Ryan generator, for the Hart Memorial Library, Troy, N. Y.; one 15 by 16 inch engine, for the Southwestern Coal & Improvement company, Parsons, Kan.; one 11 by 12 inch engine, for the Keystone Coal Mining company, Lawsonham, Pa.; two 14 by 14 inch engines, direct-connected to two 75 kilowatt Thompson-Ryan generators, for Cambridge Springs company, Cambridgeboro, Pa.; two 15 by 16 inch engines, direct-connected to two 100 kilowatt generators, for the Metropolitan Theater, Buffalo, N. Y.; two 250 horse power engines, for the Berwind-White Coal Mining company, Osceola Mills, Pa.; one 9 by 8 inch engine, direct-connected to 20 kilowatt generator, for the North Texas Bank building, Dallas, Tex.; one 6 by 6 inch engine, direct-connected to eight kilowatt generator, for the Coronado apartment house, New York; one 80 kilowatt belted generator, for the American Bridge company, Chicago, Ill. The Ridgway company has been doing business less than two months, and is making good progress.

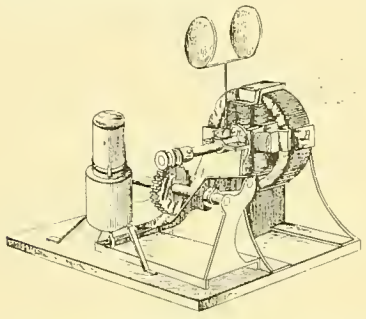
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 4, 1897.

581,706. Electric Switch. George T. Eyanson, Philadelphia, Pa. Application filed March 21, 1896.

The switch comprises double circuit terminals, pivoted blades for the respective sets of terminals, an open frame or yoke connecting the blades, an operating arm extending through the frame or yoke, so as to have vertical play therein, and oppositely acting springs co-acting with the arm and the respective blades.

581,715. Electric Cable. Max Guilleaume, Mülheim-on-the-Rhine, Germany. Application filed October 18, 1895. Patented in Switzerland June 27, 1895; in France July 8, 1895; in Belgium August 19, 1895; in England August 20, 1895; in Norway September 4, 1895; in Hungary September 5, 1895; in Italy October 8, 1895; in Spain October 30, 1895, and in Austria December 2, 1895.



NO. 581,802.

An electric cable, comprising conductors, each inclosed within an insulating envelope, the material of which is, so far as possible, out of contact with, and is unsupported by, the conductor, the envelopes being inclosed within a soft "pressing" of rubber or similar protective material applied in a plastic state and without crushing the envelopes upon the conductors.

581,718. Electric Cigar Lighter. Henry M. Handshy, San Antonio, Tex. Application filed August 10, 1896.

There is the combination with the base-casing, tubular standard rising therefrom, separated contact-lugs in the upper portion of the standard, wires leading from the base-casing through the standard, the wire being connected with one of the contact-lugs and the wire passing through an opening in the standard, and a wire extending from the remaining contact-lug through an opening in the standard, of a spring-actuated bell-crank lever fulcrumed within the standard, a lighting handle supported from the wires, a platinum plate on the lighting handle, the plate being connected on opposite sides with the ends of the wires, and the last-named wires being connected with the outwardly extending arm of the lever.

581,769. Electric Railway. Harry C. Reagan, Jr., Philadelphia, Pa. Application filed December 2, 1896.

Included in this arrangement are an electric motor, an air compressor and an air storage reservoir, pipes leading to and from the reservoir, and having connection with a discharge chamber of the compressor and with the valve-chest of the latter respectively, an electro-magnet suitably supported, and connections common to the motor and magnet.

581,802. Aero-electric Whistle. Charles R. Alsop, Middletown, Conn. Application filed July 13, 1895.

In a device of the character described is a signal, consisting of a suitable motor, a worm connected to the shaft thereof, a worm-wheel meshing therewith, a lug carried by the worm-wheel, a lever operated by the lug, and an air-pump having a sounding mechanism adapted to be operated by the lever.

581,815. Telegraphy. Charles F. Eaton, Jr., Santa Barbara, Cal. Application filed July 18, 1896.

A rotating character plate is located at the receiving end of the line, and a rotating commutator at the sending end moving in unison and provided with contacts corresponding in position respectively with the characters on the character plate; a camera at the receiving end is arranged to photograph the characters on the character plate; electro-magnetic apparatus is provided for operating the shutter of the camera, and an electric circuit, including the electro-magnetic shutter apparatus, is adapted to be closed by any of the contacts on the commutator.

581,840. Tool or Appliance for Use in Truing Up Commutators of Dynamos, Electric Machines, etc. Walter P. Adams, London, England. Application filed August 15, 1896. Patented in England November 18, 1894.

In a device for truing up or polishing cylindrical surfaces a frame is provided with a handle and two projecting arms, one of which is pivoted or hinged to the frame, and a flexible strip connected with the ends of the arms.

581,873. Electric Transformer. Elihu Thomson, Lynn, Mass. Application filed January 29, 1890.

In an iron-clad transformer, the laminated iron envelope having its laminæ made each of two sheet-iron punchings fitting together from opposite sides of the coils, and each having a middle limb entering within the coils, and the two punchings having arms at each side of the central limb, which meet each other out of coincidence with the middle of the coils, and with successive laminæ reversed, so that by the unequal length of their limbs they shall break joints.

581,997. Electric Arc Lamp. Moses S. Okun, New York, N. Y. Application filed August 30, 1895.

The carbons are in the main circuit, and a feeding magnet is in the secondary of an induction coil whose primary is in shunt to the main circuit.

582,036. Electrical Fuse Cut-out. Waldo C. Bryant, Bridgeport, Conn. Application filed March 1, 1897.

The terminals consist each of a headed screw and an interiorly-threaded flange tube, into which the screw fits, the insulating body having an opening to receive the tube and recessed on its opposite faces, one to receive the flange at one end of the tube and the other to form a shoulder over which the other end of the tube is flanged out.

582,090. Astatic Electrical Measuring Instrument. August Raps, Berlin, Germany. Application filed October 1, 1896.

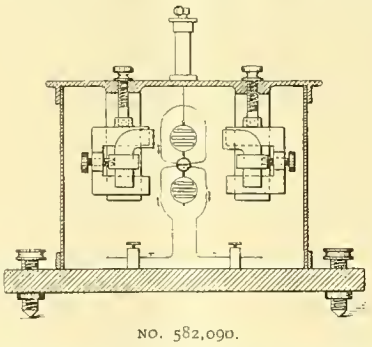
The first claim is for the combination with an astatic galvanometer or electro-dynamometer of a pair of suitably shaped cores made of magnetic unmagnetized metal, such as soft iron, placed at a greater distance from the stronger magnet of the astatic system than from the other.

582,102. Controller for Electric Cars. Albert Schmid and Harry P. Davis, Pittsburg, Pa. Application filed January 17, 1895.

A rotatable contact-bearing cylinder is arranged in combination with a shaft for rotating the same, the shaft being detachably connected with the cylinder, and being longitudinally movable when disconnected therefrom.

582,107. Selective Signaling Circuit, Apparatus and System. George W. Whittemore and John A. Barrett, Brooklyn, and Warren M. Craft, New York, N. Y. Application filed November 28, 1896.

Claim 1: An electric signaling system comprising a metallic or double conductor, main circuit extending between a central station and a number of sub-stations; a selective signal apparatus consisting of a signal-receiving device in a local circuit controlled by two relays at each sub-station, the receiving device at each station being selectively responsive through the said relays to a definite and separate or different main-circuit current or current combination, and at the central station a source of calling-current; an earth conductor and a series of keys representing respectively the said sub-stations and controlling the connection



NO. 582,090.

of the two main-circuit conductors, the call-current source and the said earth conductor terminals each key being organized to establish a different relation of the said terminals, and adapted thereby to transmit over one or both of the said main-circuit conductors, the particular current or current combination to which the receiving device of the sub-station represented by such key, and no other, is responsive.

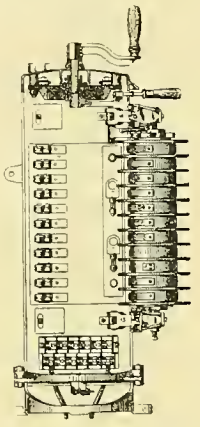
582,111. Switch for Electric Circuits. Alexander J. Wurts, Pittsburg, Pa. Application filed November 14, 1896.

This is a switch for electric circuits, comprising a blade and a co-operating jaw, consisting of a pair of bundles of laminæ projecting outwardly from their support toward each other and terminating in planes which are inclined with reference to the co-operating surface of the blade, and which are separated by a space, the maximum width of which is equal to or slightly less than the minimum thickness of the switch-blade, whereby the free ends of the laminæ will be successively engaged and slightly moved, one at a time, from their normal positions by the blade.

582,114. Controller for Electric Motors. Harry P. Davis, Pittsburg, Pa. Application filed January 14, 1895.

A cut-out plug having a base and an approximately cylindrical contact-piece partially divided by sets of longitudinal spaces or slits at right angles to each other, the spaces or slits of one of the sets extending to the base, and the other to the extremity of the free end of the contact-piece.

582,115. Method of and Means for Controlling Electric Motors. Harry P. Davis, Pittsburg, Pa. Application filed January 14, 1895.



NO. 582,102.

The method is described of controlling mechanism operated by two electric motors, comprising the following steps: Connecting the motors in series with resistances, cutting out the resistances in order to reach a running position, and then reinserting a portion of the same, shunting one of the motors and then cutting it out, connecting the motors in parallel without the resistance previously in shunt, then cutting out all the resistances.

582,120. Astatic Galvanometer. Adolph Franke, Berlin, Germany. Application filed September 29, 1896.

The combination of a swinging system of astatic needles, and attached thereto a second adjustable magnetic system considerably weaker than the first system.

582,131. Alternating Current Regulation and Distribution. Benjamin G. Lamme, Pittsburg, Pa. Application filed March 27, 1893.

The method of harmonizing the phase relation between current and electromotive force in an alternating current circuit consists in counteracting the existing displacement of phase by adding to the existing waves of current and electromotive force independent corrective waves which are generated by the inductive action between the armature and field of an electro-dynamic phase controller, and which bear such relation to the existing waves as to establish a substantially harmonious relation.

582,132. Alternating Current Motor. Benjamin G. Lamme, Pittsburg, Pa. Application filed October 30, 1895.

An electric motor is described, comprising an armature having a distributed winding, a starting resistance normally in circuit therewith, a short-circuiting device for the resistance surrounding the winding, and means for moving the device into and out of direct engagement with the winding.

582,149. Electrical Switch. John A. Spiker, Grand Island, Neb. Application filed May 14, 1896.

This device may be used for telegraph or other instruments, and consists of a slotted base, a series of radially disposed contact-plates, binding posts connected to the contact-plates, and a spring for each plate, combined with a revoluble lever, a sliding plate carried by the lever, a spring-actuated sliding arm connected to the sliding plate at one end, and adapted to make connection at its other with the springs, the lever being adapted to contact with the radial contact points.

582,157. Telegraphic Apparatus. Charles F. Eaton, Jr., New York, N. Y. Application filed December 18, 1896.

The apparatus described consists of a line circuit, means at a sending station for mechanically determining the characters to be sent, means for disclosing the characters at the receiving station, a commutator at the sending station for selecting the characters to be disclosed at the receiving station, a motor for actuating the commutator, and a shunt connecting the incoming and outgoing wires at a station, the shunt including a switch and a greater resistance connection around the switch.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MAY 22, 1897. No. 21

Francis B. Crocker.

A better selection for the presidency of the American Institute of Electrical Engineers could scarcely be made than that which the nominating committee submitted for the ratification of the members at the annual meeting in New York on May 18th. Francis B. Crocker is eminently fitted for the position, and under his administration it may be expected that the organization will enjoy a successful career. He has been identified with the Institute so closely from its inception that he is thoroughly conversant with all that pertains to its history, its successes and failures, and he will undoubtedly make use of this knowledge in directing the course of the association during his term of office.

Prof. Crocker has occupied a prominent position in the electrical fraternity for many years, being a successful designer, an author of some note in the field of electrical literature and an instructor of marked ability; his experimental work has resulted in many important discoveries; the commercial enterprises in which he has engaged have achieved success, and his record in connection with scientific gatherings, partaking somewhat of the nature of public bodies, has been very creditable. Altogether, Prof. Crocker's career has been a busy as well as successful one, as a brief biographical sketch will show.

Born in New York city, July 4, 1861, Francis B. Crocker began to try electrical and chemical experiments at the age of 12 years. He entered the School of Mines, Columbia College, in 1878, and graduated in 1882 with the degree of engineer of mines, receiving a training in mathematics, physics, mechanics, chemistry, general engineering, metallurgy and mining. He received from Columbia the degree of Ph. D. in 1895. In 1883 he formed, with Charles G. Curtis, the firm of Curtis & Crocker, patent attorneys and experts. At the same time he worked in collaboration with C. G. Curtis, S. S. Wheeler and C. S. Bradley on experimental investigations relating to telegraphy, telephony, electric light and power and electro-metallurgy, thus obtaining a varied practical experience with the important applications of electricity and developing a number of inventions. Messrs. Curtis and Crocker, in 1886, established the C. & C. Electric Motor company, which was one of the first and most prominent enterprises in the field of electric power, and played an important part in the introduction and commercial application of electric motors. In 1888 Messrs. Crocker and Wheeler organized the Crocker-Wheeler Electric company, which has steadily grown until it is now among the most active and successful manufacturers of electrical machinery in this country to-day. When the course in electrical engineering was established at Columbia College in 1889, Mr. Crocker was selected to take charge of it, and he has succeeded in placing Columbia in the front rank of electrical educational institutions. When the university moves into its new buildings next fall the greatly increased space and facilities will still further strengthen its electrical engineering department. Prof. Crocker was permanent secretary of the International Electrical Congress, held at Chicago in 1893, assisting the chairman, Dr. Elisha Gray, in the management of that meeting and also having charge of the publication of the proceedings of the congress. He has been manager and vice-president of the American Institute of Electrical Engineers for two terms in each office and a member of many of its working committees. He was also president of the New York Electrical Society for several years. He was appointed as the representative of the American Institute of Electrical Engineers in the National Conference on Standard Electrical Rules, and was elected chairman of the committee on code, which, in co-operation with the National Board of Fire Underwriters, has formulated a revised code for general adoption. He proposed the name "henry" for the unit of inductance and secured its indorsement by the American Institute of Electrical Engineers, resulting in its final adoption by the Electrical Congress of 1893. He is the author of a work on "Electric Lighting," and is joint author with Dr. S. S. Wheeler of a book on "The Practical Management of Dynamos and Motors," both of which have been successful. He has written many papers and articles for scientific societies and journals, covering a wide range of subjects, and has also delivered several courses of public lectures.

FRANCIS B. CROCKER.

It is scarcely necessary to refer to Prof. Crocker's many excellent personal traits, as he is so widely known as to make this almost superfluous. He is eminently fair minded and has a pleasant manner; but at the same time he possesses a very determined character, all of which well qualifies him for a presiding officer. Prof. Crocker's election will prove particularly gratifying to those western members of the Institute who are earnestly striving to build up an influential branch in Chicago.

Chicago Electrical Association.

The announcement of the annual dinner of the Chicago Electrical association at the Leland Hotel on May 21st reminds the electrical fraternity that this organization has done exceptionally good work during the season just closed. The society is deserving of encouragement and recognition and the officers are to be congratulated upon the success which they have won.

American Institute of Electrical Engineers.

Since the announcement was made of the ticket selected by the nominating committee of the American Institute of Electrical Engineers it has been conceded that the annual meeting on Tuesday, May 18th, would be merely a formal ratification of the action of the nominating committee, in making the following selections:

President, Francis B. Crocker, New York.
Vice-presidents, A. E. Kennelly, Philadelphia; Charles S. Bradley, New York; Dugald C. Jackson, Madison.
Managers, Alexander Macfarlane, South Bethlehem, Pa.; Gano S. Dunn, New York; W. F. C. Hasson, San Francisco; Herbert Laws Webb, New York.
Treasurer, George A. Hamilton, New York.
Secretary, Ralph W. Pope, New York.

The officers whose terms have not expired are: Vice-presidents, Charles P. Steinmetz, Schenectady; Harris J. Ryan, Ithaca; Wilbur M. Stine, Chicago; managers, Charles F. Scott, Pittsburg; Bion J. Arnold, Chicago; Carl Hering, Philadelphia; Cary T. Hutchinson, John W. Lieb, Jr., and F. A. Pickernell, New York; William L. Puffer, Boston, and L. B. Stillwell, Niagara Falls.

Much interest is manifested in the arrangements for the general meeting on July 26th. Announcement has already been made that this meeting will be held at Greenacre-on-the-Piscataqua, Eliot, Maine, the residence of the late Moses G. Farmer, who was one of the charter members of the Institute and whose valuable aid in building up the organization was recognized by the Institute when it made him an honorary member on October 21, 1890. The date selected for this year's gathering will be the 50th anniversary of Prof. Farmer's relinquishment of teaching and the taking up of electrical work. Greenacre is delightfully situated on the east bank of the Piscataqua River, about 10 miles beyond Portsmouth, N. H., and is reached in two hours from Boston. Of late it has occupied some prominence in the educational world owing to the lectures delivered there during the last few summers by some of the most prominent workers in American literature, science, art and religion. This movement was started and developed by Miss Sarah J. Farmer. The plans had been carefully considered before her father's death and the project received his enthusiastic support. Because of this fact it was considered appropriate to hold the annual meeting of the Institute at Greenacre this year, and the date set was the last week in July, at which time it is Miss Farmer's purpose to commemorate the 50th anniversary of her father's earliest work in the electrical field, involving the application of electricity to railway work, which has now become such an indispensable factor in the life of great cities, and in solving the problem of suburban communication. The lectures of the conference will commemorate different phases of progress in electrical science, and there will be an exhibition during July of interesting material illustrating the earliest attempts at motor-traction by means of electricity, and the subsequent evolution of this method of transportation. Miss Farmer has been assured of the co-operation of the Patent Office in obtaining material for this exhibit, from which a few early models will be taken. The loan collection will, in the main, be a graphic one. Miss Farmer is anxious to hear from persons possessing models, drawings and any portable material bearing upon this subject, and willing to permit their use in this exhibition. The meeting and exhibition should result in important acquisitions to the history of the development of this important branch of electrical industry.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part VI.

Piping.

In the last three lectures the functions of the different parts which go to make up the steam power plant of a power station have been considered separately; the influence of each upon the station economy has been shown, and the advantages and disadvantages of the types of each appliance—boiler, engine, heater, condenser, pump, economizer and purifier—have been discussed.

These different parts of the equipment for the use of steam are connected by means of the piping system. For instance, by means of pipes the steam is conveyed from the boiler to the engine, and thence the exhausted steam is taken either to the atmosphere or is carried to the condenser; in either case it returns to its original state, water. Pipes take the injection water to and from the condenser and convey the feed-water through the system of heaters, purifiers and economizers to the boilers, while separate systems of piping must be provided for lubricating and for fuel oil, if the latter is used.

Piping, then, is naturally divided into three general classifications—steam, water and oil piping. The steam piping may be further divided into live-steam and exhaust-steam piping, the water piping into feed and condenser piping and the oil piping into lubricating and fuel-oil piping.

In the following discussion it will be our object to point out the general schemes for the arrangement of piping; to show the materials of which the pipes are made and to describe some of the principal details of erection.

That we may have clearly before us the relation of the various parts of the plant to each other and to the general plan of piping, three diagrams have been prepared. It is to be understood that these diagrams do not show details and are intended only as simple figures to show as plainly as possible the circuits of steam and water.

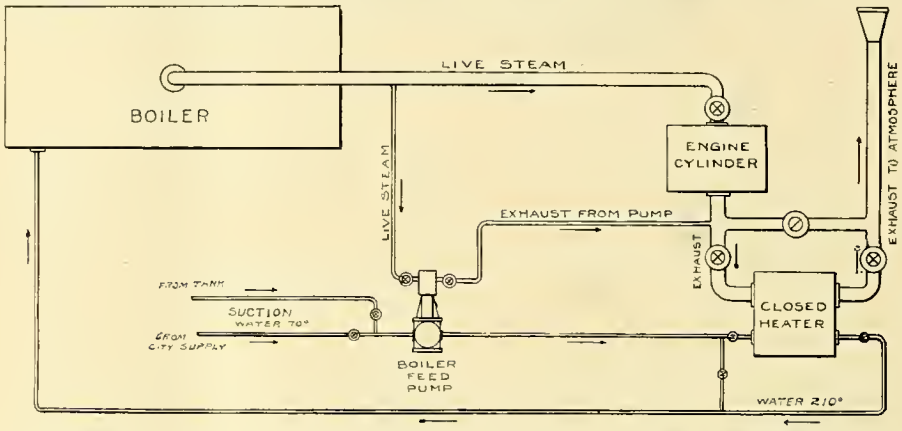

FIG. 22. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM OF PIPING OF NON-CONDENSING PLANT.

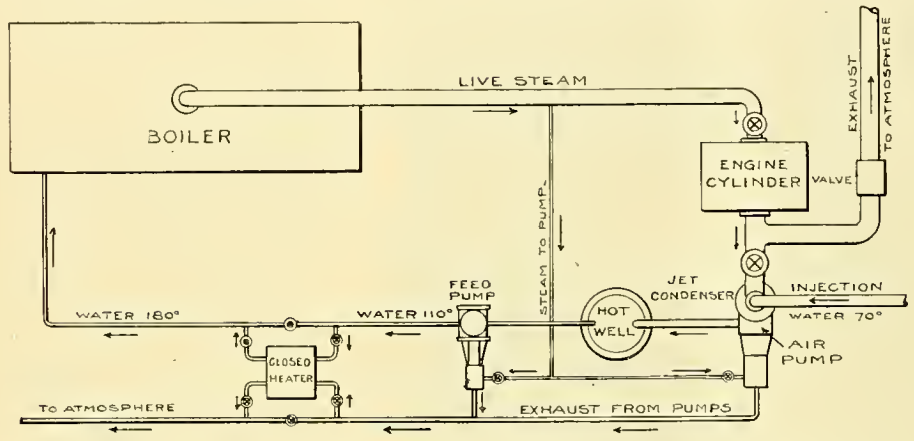

FIG. 23. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM OF PIPING FOR CONDENSING PLANT.

Fig. 22 shows the diagram of piping for a non-condensing plant. No trouble will be found in following the live steam from the boiler to the engine, from which it is exhausted through a heater into the atmosphere. It will be noticed that a by-pass has been provided, with valves located so that the plant can be operated with or without the heater. Thus, if necessary, the heater can be cleaned or repaired while the plant is in operation. The water enters the heater from the source of supply by means of a pump or gravity at a temperature of say 70° Fahrenheit and here absorbs a part of the heat of the exhausted steam and passes on to the boiler at a temperature of 200° to 210°. If a closed heater is used, the water can be forced from the supply through the heater and into the boiler by the use of but one pump; but if an open heater is thought desirable the water from the source must be fed to the heater by gravity, as from a tank on the roof or under pressure from city mains, or else another pump must be used between the heater and the boiler. An auxiliary pipe is shown running directly from the boiler-feed pump past the heater, to be used when the heater is out of use from any cause. The course of the live steam to, and the exhaust steam from, the feed pump will be readily seen.

Fig. 23 shows a diagram of the piping of a condensing plant using a jet condenser. The live steam, passing through the engine as before, exhausts into a jet condenser, where it comes in contact with the cold injection water and is immediately condensed. The air pump maintains the vacuum in the condenser and pumps the water into a "hot well." This well consists usually of an open tank provided with an overflow. On the "exhaust line," between the engine and the condenser, an exhaust pipe leading to the atmosphere is placed. This exhaust pipe is for use when the condenser is out of order and is provided with an automatic relief valve which will allow the exhaust steam to escape into the air if for any reason the condenser should lose its vacuum, which it sometimes does by becoming hot on account of too great a quantity of steam being delivered to it for the amount of injection water. From the hot well the water is taken at a temperature of about 110° and forced through a heater, where its temperature is raised, and on into the boiler. This heater is intended to utilize the latent heat of the exhaust steam from the pumps, which would otherwise be lost. Of course if direct-driven pumps, operated from the main engine or by electric motors, are used, there will be no exhaust from the pumps and no heater will be used at this point. The heater in the diagram is marked "closed heater," but it is to be understood that an open heater could be used instead, with the provision that two pumps would be necessary unless the feed-water runs by gravity from the hot well to the heater. As has already been mentioned, hot water should always gravitate toward a pump. As in the first case, provision is made to cut out the heater, and a source of supply independent of condenser and hot well should be provided for use in case of emergency.

Fig. 24 shows diagrammatically the piping connections of a condensing plant using all the possible auxiliaries. Here the steam exhausts through a *closed* heater into a surface condenser, where it is condensed and is pumped by the air-pump into the hot well. The condenser is provided with an independent circulating pump, which takes the water from its source of supply, forces it about the cooling surfaces of the condenser and discharges it back to be cooled again. The exhaust line is furnished as before with an escape to the atmosphere, containing an automatic valve. From the hot well the water is (by means of the pumps shown) forced through the two heaters. The first heater must necessarily be of the closed type in order to maintain the vacuum on the engine exhaust, and should be carefully designed to avoid any possibility of leakage. This heater will impart some heat from the exhaust steam to the feed-water, and will raise its temperature to about 135°. The second heater, which may be of either the open or closed type, utilizes the latent heat of the pump exhaust or other station auxiliaries, and will raise the feed-water to a temperature of about 200° to 210°, if there is sufficient steam entering it from the auxiliaries in the plant. From this point the water passes through the economizer into the live-steam purifier and thence into the boiler. The conditions under which an economizer or live-steam purifier are to be used have already been discussed. Either one is capable of taking the water at a temperature of 200° and raising it to the temperature of the live steam, but if both are used the temperatures will be about the same as shown on the diagram. A by-pass is usually provided, so that any appliance can readily be cut out of service; in fact, provision must always be made whereby an accident to any part of the equipment will not cripple the entire plant.

We are now in a position to look into the practical details of installation. Commencing with the live steam piping, let us examine first into the general systems in use. These are variously known, but for convenience and simplicity we will classify them as follows:

1. The simple system.
2. The multiple system.
3. The loop system.
4. The duplicate multiple system.

The *Simple System* was the original one, and is in use wherever one engine and one boiler are to be connected, being simply a pipe rising up from the boiler and going thence over and down to the engine (Fig. 33, p. 287). A further amplification of this came as the engine units grew larger, and two or more boilers were connected together to the one pipe which went over to the engine. This system answers very well for one large engine connected to a number of boilers. Generally, in modern practice, the boilers are connected to a large header, and from this header the steam is taken for the engine, thus making somewhat of a reservoir for the steam, and avoiding the drawing of steam too heavily from any one boiler. But for electric power houses especially, more than one engine unit and many boilers were found necessary.

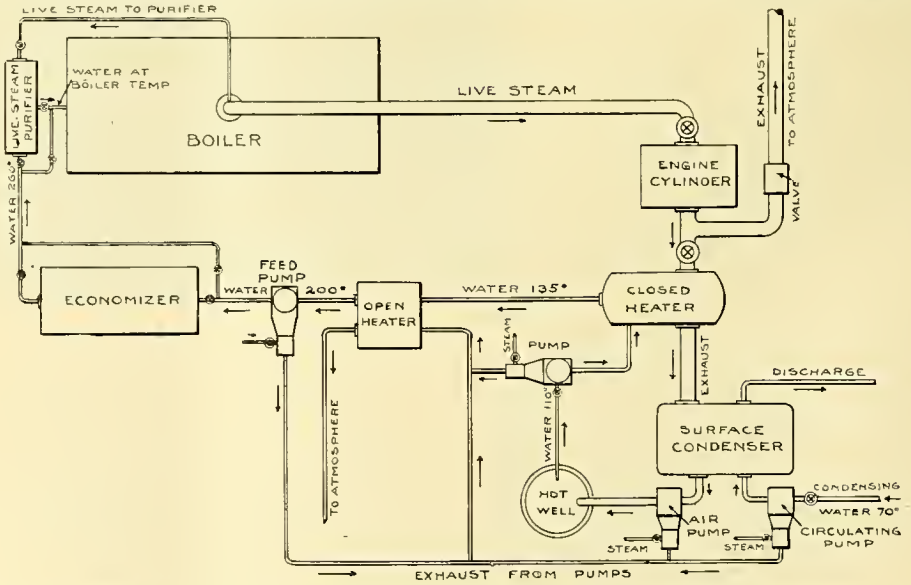

FIG. 24. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM OF PIPING FOR CONDENSING PLANT, WITH ECONOMIZER AND PURIFIER.

Thus we have in the *Multiple System* a large header connected with which are all the boilers and all the engines, so that any engine may be supplied with steam from any boiler or series of boilers. This is the system in use in all modern plants of any size. All other systems of piping, however complicated, are simply modifications of this one. Figs. 25, 26 and 27 show arrangements of piping with headers. It will readily be seen that any number of engines and boilers can be attached to the header. Precaution must be taken, however, to see that no engine lead comes directly opposite a boiler opening, as in that case a sudden increase in load upon the engine would result in a correspondingly increased demand for steam upon that one particular boiler instead of dividing it among the "battery" of boilers.

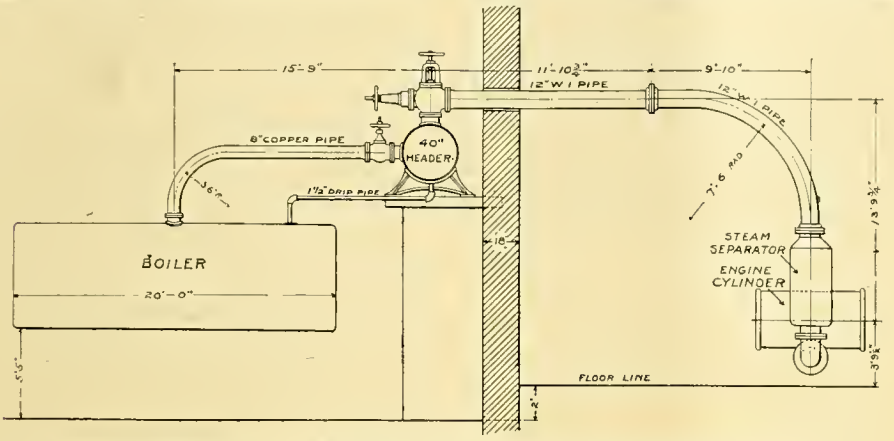

FIG. 25. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LIVE-STEAM PIPING OF CHICAGO CITY RAILWAY COMPANY'S NEW PLANT.

It is generally necessary, on account of the length of these main headers and consequently their great expansion at the high temperatures used, to divide them up into two or more parts, connecting these separate parts by copper bends or in some other manner to provide for their expansion. This construction is shown in Fig. 28 (p. 286). Stop valves must also be furnished at each connection of this kind, as well as at the connection to each engine and boiler, so that any portion of the system may be cut out for repairs without necessitating the shutting down of the plant or the crippling of any considerable portion of the units.

A smaller steam header is generally run to supply steam to the various auxiliary units, such as pumps, air-pump engines, fans, stoker engine, etc. This header takes steam from the main header.

The *Loop* or *Ring System* is used largely in Europe and differs from the multiple system in that the ends of the main header are brought back and connected to another header over the boilers, so that steam is fed into both ends as well as into the center of the header.

The *Duplicate* or *Multiple System* is the most complicated system of piping, and is in use in a few of the more recently built stations. It consists of two header systems lying side by side, to which each engine and each boiler are connected, so that almost any part of the piping system may be cut out and yet a way be left for supplying steam to the engines. This system, while perhaps the best of all, has as yet not been largely adopted owing to its cost.

Size of Piping.—In regard to the sizes of piping used in any or all of these systems, there may be considerable difference of opinion among engineers. Each designer is confronted by two opposite desires; one is to keep the cost down to a practical limit, and the other is to have sufficient capacity for sudden demands. Each engine builder has his own ideas as to what sizes should be used for the steam connections to his engines. The boiler makers, at least those manufacturing water-tube boilers, have a fairly uniform system of sizes for each capacity. Thus these two sizes are fixed to start with, and all that remains is to proportion the sizes of headers.

It is good practice, especially where the engines are some distance from the header, to increase the size of the engine leads one size up to the engine and then decrease to the size desired. The principle to be observed in header design is to have them large enough so that the velocity of steam leaving the header at any point will not be so high as to draw steam unduly from any boiler. The header, if large, acts as a reservoir for steam and also as a separator for the entrained water, and is an additional safeguard against carrying water over from boilers to the engines. The latter is liable to occur, with disaster to the engines, even should steam separators be placed near the engines, if the headers and piping are too small.

On the other hand, the headers may be so large as to expose too much surface to radiation. On extremely high-pressure lines especially, for use with triple-expansion engines, where pressures rather than volumes are to be considered, the element of increased safety which small headers have over large ones and the difficulty of keeping the large header tight under these high pressures, is an important element to be considered.

The area of any main header or trunk-line pipe will be large enough if made 25 per cent. less than the combined areas of all the pipes leading into it, and a flow of steam of 6,000 feet per minute through any pipe may be considered a maximum.

Location.—As to the location of steam headers in reference to the boilers there are two methods—first, by placing the header below the water line of the boiler, and, second, by placing it above the water line. The first method has the advantage of appearance. All the pipes in the engine room are then below the floor, leaving the entire room free from ungainly pipes and clear of the traveling crane if there is one, while at the same time it is much easier to furnish suitable and stable foundations. The disadvantages of this method are that it necessitates making the boiler leads to the header quite long, causing greater condensation, and the header being below the water line of the boilers, something more than the ordinary methods must be applied to take care of the drainage.

Where the header is located above the boilers, as shown in Figs. 25 and 27, the connections become shorter, and with fewer joints there is likely to be less trouble with leakage. It is generally possible to carry the header on I-beams which are only partly supported by the boiler brickwork, and sometimes possible to carry it entirely from the steel work or on the walls of the building, thus avoiding the evil effects of expansion or settling in the supporting brickwork of the boilers. The boiler brickwork is never designed to carry such a load and never should be used for this purpose, unless special provision is made for carrying the extra weight.

The leads from the header to the engines, if desired, may be carried down on the boiler room side to the basement, and then up to the engines. Generally considered, the overhead method is preferable, though considerations may arise rendering the other plan necessary.

Fig. 25 shows the system of live-steam piping used in the new Forty-ninth street power station of the Chicago City Railway company. Here the header is above the boiler. The pipe from the boiler is a bent copper pipe and enters the header from the side while the wrought-iron lead to the engine leaves the header from the top. A small supplementary drain pipe extending from the bottom of the header to the boiler immediately under each boiler lead returns the water of condensation to the boiler. Fig. 26 shows the location of the header in the power house of the Toledo Traction company. Here the header is placed below the water line of the boilers and the curved leads from both engines and boilers enter it from the top. This arrangement allows abundant provision for the endwise expansion of the header, but necessitates handling the water of condensation which accumulates in the main header by auxiliary means, as hereinafter described. Fig. 27 shows the arrangement of live-steam pipes adopted by the Metropolitan West Side Elevated Railroad company of Chicago. In this case vertical engines were used and the header was located so that the boilers leads enter it from the bottom, while the pipes leading to the engines leave it from the top, which allows the water of condensation in the steam pipes to return by gravity to the boiler through the steam pipes themselves. A gallery was provided extending the length of the header, which gives easy access to the valves.

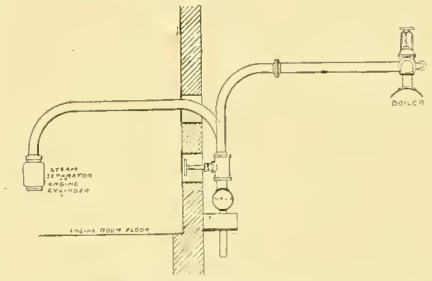

FIG. 26. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LIVE-STEAM PIPING OF TOLEDO TRACTION COMPANY'S PLANT.

Construction and Material.—Headers are made in many different ways. Sizes up to 24 inches in diameter may be made of pipe and fittings, or of pipe alone with riveted nozzles or saddle flanges. Above 24 inches they are always built up of boiler steel with nozzles riveted on. A detail of a riveted nozzle is shown in Fig. 29. The practice of riveting saddle flanges on pipes of small diameter is to be condemned, as flanges of this description will rarely remain tight for any length of time. Indeed, riveted joints of any kind, especially between cast and wrought iron, are apt to cause trouble by leakage.

Cast-iron headers have been tried and in some cases have proved successful (see Fig. 27), but cast-iron in long pipes is obviously not the proper material for a header. The liability of concealed flaws and inherent strains in the casting itself renders its use dangerous. Cast in short pieces, as in fittings, it is much easier to obtain a casting free from flaws, and it answers the purpose very well. Cast-steel, with its high tensile strength, would be excellent, of course, if it could be obtained in long pieces, soft enough to machine and free from pores, but at this stage of the art of making steel castings this seems impracticable. Such castings are generally spongy and so unfit for such purposes, although an occasional good casting is obtained. The preference, then, should be for wrought-iron pipe and heavy fittings with flanges properly screwed on, as will be described later, in sizes up to 24 inches, and for larger sizes a carefully built up riveted header with nozzles riveted on. Steel castings for nozzles and flanges are coming into use and seem to do good service.

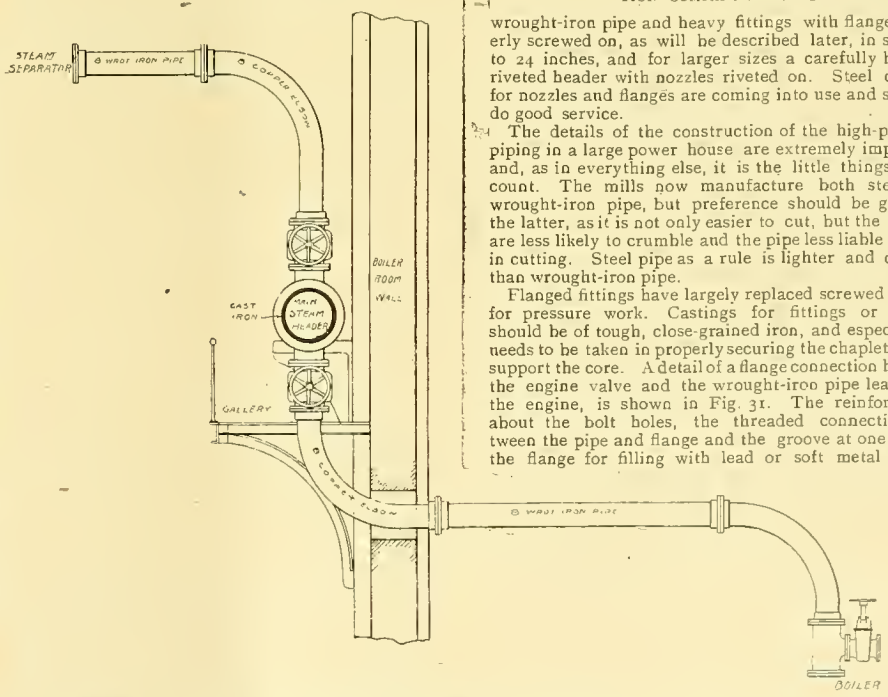

FIG. 27. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LIVE-STEAM PIPING OF METROPOLITAN WEST SIDE ELEVATED RAILWAY COMPANY'S PLANT.

The details of the construction of the high-pressure piping in a large power house are extremely important, and, as in everything else, it is the little things which count. The mills now manufacture both steel and wrought-iron pipe, but preference should be given to the latter, as it is not only easier to cut, but the threads are less likely to crumble and the pipe less liable to split in cutting. Steel pipe as a rule is lighter and cheaper than wrought-iron pipe.

Flanged fittings have largely replaced screwed fittings for pressure work. Castings for fittings or flanges should be of tough, close-grained iron, and especial care needs to be taken in properly securing the chaplet used to support the core. A detail of a flange connection between the engine valve and the wrought-iron pipe leading to the engine, is shown in Fig. 31. The reinforcement about the bolt holes, the threaded connection between the pipe and flange and the groove at one end of the flange for filling with lead or soft metal will be noticed. Fig. 32 shows a ribbed cast-iron head for closing the end of a header or large pipe. The flange, which is riveted to the pipe by a double row of rivets, is of cast-steel. The end of the pipe and the inside of the flange are first rough turned and then the flange is shrunk onto the pipe, after which the holes for the rivets are drilled and the flange caulked inside and out.

Threads should be cut long and of uniform taper. The great difficulty with defective threads is that the thread on the pipe and the thread in the flange are not of the same taper and consequently only two or three threads are tight while the others are loose and useless. On account of the spring of the pipe in cutting the

thread, no thread, whether cut by dies in a pipe machine or by a tool in a lathe, is perfectly round. The thread in the flange, on the contrary, since the flange cannot spring, is perfectly round, so that in order to make a perfect joint, suitable for high pressure, the flange is screwed tight on the pipe until even with the face of the flange. Then it is peened all around opposite the thread inside, until the metal is stretched and fills the thread in the flange, metal to metal. Then, as an additional safeguard on headers and large pipes, the pipe should be swung in a lathe and the pipe and flange faced off together, thus presenting the end of the pipe to the face of the gasket in the joint.

All faces of flanges and fittings should be faced with

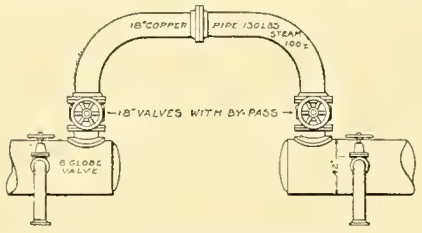

FIG. 28. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—EXPANSION BEND IN STEAM HEADER.

a tool, leaving either a grooved surface or else a series of concentric rings to bite into and retain the gasket. The bolts should be ample in number and size and spaced not over 3½ inch centers. An allowance of a strain of 3,000 pounds per square inch should be the maximum strain on each bolt. For the sake of convenience in turning the fittings, the bolt-holes in the end flanges should be drilled in multiples of four, and such drilling be done so that the center line of the fitting will divide the space between the holes. Odd or irregular drilling should be avoided, and the center to face distances of all fittings of the same size should be made the same as far as possible to facilitate changes or repairs.

Expansion.—One of the most important things to be provided for in any system of piping is the expansion. Especially is this true of high-pressure work, where the high temperatures increase the expansion largely. The coefficient of expansion for wrought-iron pipe may be taken as .000006 of its length for one degree Fahrenheit, so that for a pipe 200 feet long working at a temperature of 360° it may easily be over two inches. If provision is not made for such expansion, not only will joints start to leak, but the safety of the entire structure is imperiled.

Piping should be arranged as far as possible with swinging joints, so that one part can travel without affecting the safety of the whole. This construction is shown in Figs. 26 and 27, where bent pipes lead from the boiler and curved wrought-iron pipes connect with the steam separator. Copper or wrought-iron pipes may be used for these bends, but copper is generally used where the radius of the bend is less than six diameters of the pipe. Slip joints, which are sometimes used to take up expansion in low-pressure heating work, are entirely inadmissible for power-house work. Headers should be joined together by copper pipes bent in the form of a ∩ or "goose," as it is sometimes called (see Fig. 28). Copper pipes are made either with heavy brass or bronze flanges brazed on the ends, or with a loose steel flange placed on the pipe, and the end of the copper pipe turned over and reinforced on the back with a light copper flange.

Wrought-iron bends are threaded and furnished with flanges of steel or cast-iron in the same manner as the remainder of the piping. Such bends are coming into very general use. They afford an easy passage for the steam, present a good appearance in the engine or boiler room, and provide for a certain amount of expansion. They are much stiffer than is generally supposed, however, and will not take care of the expansion where the pipe line is long.

Headers and large pipes should be supported on rollers or suspended by chains, so as to allow expansion in all directions. Other pipes should be carried by wrought-iron forged hangers. A header supported by cast-iron rollers is shown in Fig. 30.

Valves.—Valves for steam piping are of two general classes—globe valves and gate valves. The globe valves offer the greater resistance to the passage of the steam. Both kinds should be fitted with bronze seats or disks, bronze being much better than any composition or soft metal, as the bronze can be refaced. It is important to install valves which can be reseated without taking the valves from the pipe line. The spindles should be of steel and the glands should be so constructed that they may be repacked without shutting down the plant. Valves are preferably fitted with some means for indicating at a glance whether the valve is open or closed. On high-pressure lines a by-pass should always be provided on all valves from eight inches up, to admit the steam slowly and equalize the pressure before an attempt is made to open the main valve. In placing a globe valve in the steam line it should be set so that the steam pressure is beneath the valve. Large valves are of cast-iron or steel; small valves are usually of brass. Brass is not used for the larger sizes, as its expense is prohibitive. When compound engines are used the piping system should be so arranged that a live-steam connection with the low-pressure cylinder can be quickly made in case it becomes necessary through accident to the high-pressure part to drive the load from the low-pressure cylinder alone. This is usually accomplished by means of a reducing value joined to the receiver at the point where the steam from the receiver enters the low-pressure cylinder. By setting the reducing valve at a safe pressure for the receiver, which should be strong enough to stand at least two-thirds the boiler pressure safely, the engine can be made to do its rated work, provided the main working parts are built strong enough.

Vibration.—One of the chief problems to be considered in any system of piping is the prevention of vibration. It is difficult to predetermine just how pipes are going to vibrate, and the most carefully designed plant will generally have to have something additional done after it is in operation. Vibration is very disastrous in its effects. It loosens the joints, causing them to leak, and if allowed to continue may in time wreck the whole system. Where a number of engines are running in a plant, at times the periods of vibration caused by the strokes of the pistons may be the same, and at such times especially, when the headers and pipes are vibrating in unison, there is great danger. This is especially liable to occur in plants using slow-speed engines. All pipes of large size should be anchored securely in one place, preferably near the middle or at some large connection, so as to divide them into two sections and to allow the expansion to go both ways. They should also

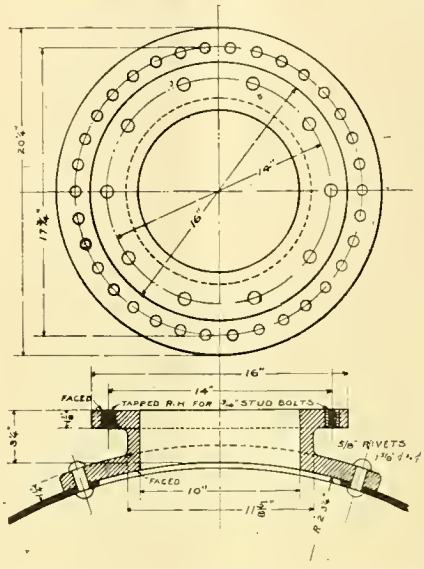

FIG. 29. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—RIVETED NOZZLE ON STEAM HEADER.

be firmly anchored sidewise by rods with turnbuckles for adjustment.

Vibration cannot be done away with entirely in all cases, as the power house itself will often vibrate to some extent, and in some instances where the walls were light permanent injury has been done to the walls by reason of the pipes being so firmly secured as to communicate their vibrations to them. Where pipes come close to the walls it is customary to place some form of deadening material between them and the walls. Wood is often used, but it is not desirable on account of the gradual charring. Heavy springs, such as used under cars, have been tried with very good results. Where headers are carried on brackets supported by the steel work or building walls this may be very nicely done by arranging the springs in connection with rollers, so that the springs deaden the vibrations and the rollers take care of expansion. This arrangement is illustrated by Fig. 30, which shows a header supported by a bracket anchored to the boiler-room wall.

One of the most fruitful causes of vibration in piping is having the pipes too small. The remedy is obvious. The conditions may be improved in any station already built, where it is not permissible to change the whole system, by placing in the pipe near the engine a small reservoir. This may be merely a piece of pipe several sizes larger and two or three feet long inserted near the engine.

Leakage.—Probably the thing which gives the operating engineer the most trouble is leakage, so that joints and the prevention of their leakage is the next thing to be considered. There is only one way in which to have joints tight, and that is to make them properly. Half-way measures will not answer. We have indicated previously in this lecture how the joint between the pipe and flange should be made. If this is properly done, there need be no fear that the threaded joint will leak. Where extra heavy screwed fittings are used the fittings are sometimes heated and then screwed on to the pipe, as shown in Fig. 29.

Joints between flanges are made with gaskets or ground joints, but the latter are very expensive and are only used in special cases. Gaskets are of two classes, metallic and non-metallic. Of the first kind we have corrugated copper gaskets and lead gaskets. Of the second kind there are many varieties, made of various compounds, the exact composition of which is a secret, and which are known in the market by some trade-mark or the name of the manufacturer. There are also many kinds of rubber packing; some of common vulcanized rubber, others of rubber with layers of cloth inserted. Asbestos board is also sometimes used. The softer packings are not suitable at all for high-pressure work and are only to be used on water or low-pressure lines.

Where metallic gaskets are used the faces of the flanges are tongued and grooved with smooth faces to retain the gasket. The corrugations of the gasket are crushed down and form a joint, metal to metal. This may also be done with non-metallic gaskets, but generally the tongueing is omitted and the faces of the flange grooved to retain the gasket. Lead or white metal gaskets should never be used on steam or hot-water lines, for a corrosive action takes place between the two metals which soon causes the joint to leak. Gaskets should be as thin as possible, not over $\frac{1}{8}$ inch thick, as the less the material is in thickness the less the liability of blowing out. Great care is necessary in bolting up flanges that all bolts be equally tightened. Otherwise the gasket will be squeezed out on one side and ruined before the rest is sufficiently tight.

Drainage.—It is necessary that all steam piping be thoroughly drained. This may be accomplished in a number of ways. The pipe may be pitched so that the water entrained in the steam from the boiler and that resulting from condensation in the pipe itself is allowed to collect in specially provided pockets. From these pockets small pipes provided with the necessary valves lead to a reservoir or tank placed so low that the water naturally gravitates into it. From this receiver the water can be pumped back into the boiler. The pump is operated by means of a float which automatically opens a valve, when the water rises, admitting steam to the pump cylinder. The pump operates until the valve is again closed by the lowering of the water in the tank and the steam is shut off. The difficulty of getting a pump to work satisfactorily on hot water has already been referred to and is one of the chief objections to this plan.

The second method of draining the steam pipes is by means of steam traps. There are many kinds of traps upon the market, some working on the principle of the rising of a copper float, which operates a valve, causing the water to be discharged, and others operating by reason of the weight of water opening a valve for the discharge of the water. The latter type is the one to be recommended. The disadvantage of most traps, however, is the leakage of their valves, whereby a considerable amount of steam as well as water is allowed to escape and be lost.

The third and best method of returning the drainage in the steam pipes to the boiler is by means of a steam loop system, or by a gravity return system. The steam loop system is shown in Fig. 33. It consists of three parts—the riser, the horizontal and the drop leg—as shown in the figure. The drop leg is open at both ends to boiler pressure, but at the point *b* the pressure is less than at the point *a* on account of the "drop" due to friction through the main steam pipe—the separator, the riser and the horizontal. Owing to this difference in pressure, water will fill the drop leg until equilibrium is established. This column of water furnishes the pressure by means of which the water is forced into the boiler. Condensation takes place in the horizontal and in the drop leg, and this causes a constant flow of steam up the riser. This steam carries with it the water which has accumulated in the separator, and thus maintains a constant discharge into the boiler.

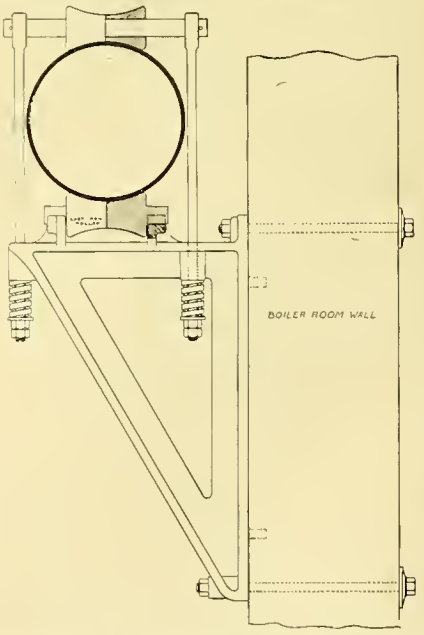

FIG. 30. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—SPRING AND ROLLER SUSPENSION FOR STEAM HEADER.

The gravity return system is shown in Fig. 34.[1] Its principal parts consist of a receiver, a riser, a separator, a return pipe and a circulating pipe, placed as shown in the figure. The water from the various drip pipes accumulates in the receiver, which is under boiler pressure. From the receiver the steam and water dis-

1. For information regarding this system the lecturer is indebted to Mr. W. A. Boyd.

charge through the riser into the separator, which is placed some distance above the water line of the boiler. Here the water and steam are separated, the water returning to the boiler by means of gravity. The circulation is set up by allowing a small amount of steam or air to escape through the reducing valve shown in the circulating pipe. This steam may be passed through a radiator or into a heater, so that the loss of heat is very small. With this "gravity return system" any number of drips can lead into one receiver, from which the combined accumulations can be carried to the separator by one pipe, while in the "loop system" a separate loop must be provided for each drain. Both systems are free from moving parts and are simple and reliable in operation if properly installed.

Pipe Covering.—It will always pay to cover the live-steam piping of a power station thoroughly and completely, to avoid the loss of heat due to radiation and convection. Currents of air circulating around the bare pipe would cause a large loss by condensation and a consequent drop in steam pressure. The most efficient pipe covering will be that which will successfully prevent radiation and at the same time protect the pipe from the cooling effects of outside air currents.

There are many coverings upon the market, composed of various materials, such as asbestos, mineral wool, magnesium carbonate, vegetable, paper and rag fibers, wool and hair. These materials are prepared in two distinctive forms for application to the pipe. The more convenient form is that in which the materials are molded into sections made to fit closely about the pipe. For straight runs these sections become split cylinders, but for valves and fittings special forms must be prepared. The other form of covering is plastic and is applied in the form of a cement or plaster.

In selecting a covering the probable life, the efficiency and the first cost should be considered. Tests have shown that those coverings composed of asbestos, wool or felt are the best. Results of tests also show that there does not exist a wide difference in efficiency between the different kinds of covering upon the market, the difference between the best and the least efficient covering being but 30 per cent.

Exhaust Piping.—Much of what has been said in reference to construction details of the live-steam pipe is also applicable to other piping in a power house. It is

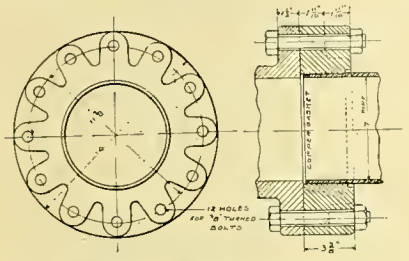

FIG. 31. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DETAIL OF FLANGE.

especially true of the exhaust piping, which should be carefully supported and anchored, thoroughly drained and ample in size. The expansion is considerably less than for live steam, but it should be provided for, nevertheless. The exhaust from each engine is led away in as direct a manner as possible to a main and thence to the atmosphere, if a non-condensing plant, and to the condensers if a condensing plant. Easy bends should be used in all cases to avoid back pressure on the engine.

Exhaust piping is usually arranged under the floor and suspended from the floor beams. In small sizes it is constructed of wrought-iron with screwed flanges and in larger sizes of cast-iron or riveted pipes. Galvanized spiral riveted pipe is very largely used for the cheaper class of work, especially for the vertical pipe to the roof. For this purpose it answers very well, but where laid horizontally it will soon rust out. For freedom from corrosion and leakage cast-iron is superior to all others. If it is used, however, flexible connections must be made to the engines so as to allow for the expansion of the inflexible cast-iron main.

Water Piping may be classed as hot-water and cold-water pipe. The hot-water pipe carries the boiler feed-water and the discharge from the condensers. The feed-water piping, like the steam line, is under boiler pressure, and the joints must be well made. It is also subject to expansion and vibration, and provision must be made for both. It is very important that the feed line be constructed so that if any part be defective its disuse will cripple no other part. For this reason feed-water headers are often run in duplicate and double connections made to each boiler. Such lines must be well supplied with valves, so that the course of the water may be changed in any desired direction. Each line must be equipped with check valves at the boilers and, if long, with one at each pump. Feed-water pumps are arranged in duplicate with at least one spare one. Often, in addition to these, the boilers are equipped with injectors. Each feed-water line should be arranged so that the pumps may draw water from the city mains or hot well or open heater and discharge the same, as has already been indicated, through the heaters, economizer and purifier into the boiler. The piping of these auxiliaries should be arranged so that any one or all of them can be cut out, allowing the feed-water to be discharged directly into the boiler. This system of connection is sometimes quite complicated, but it is necessary that a line of pipe be so arranged that any part may be completely cut out without disturbing the rest of the line.

Of cold-water pipe lines there are quite a number around any power station, such as water to journal bearings, suction to pumps, water for washing down boiler-room floor and wetting down ashes, injection and overflow piping to condensers. These names largely explain themselves. The injection pipes are often arranged in duplicate, so that in case one fails the other line may be used. They are usually constructed of flanged cast-iron pipe within the building, and if the water flows by gravity to the power house bell and spigot cast-iron pipe can be used without the building.

Easy bends should be used throughout and ample sizes. A common vacuum pipe should be run connecting with each conductor, so that any condenser may be operated with any engine, the exhaust being connected up in the same manner.

Oil and Other Piping.—Minor lines of piping in a

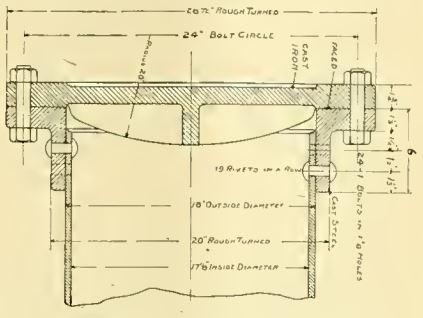

FIG. 32. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DETAIL OF CAST-IRON HEAD.

power house which may be mentioned are boiler blow-off piping, safety valve blow-off piping, gauge piping, drainage pipes, heating pipes and oil piping.

The larger and more modern stations are now equipped with complete systems for delivering oil to the cylinders and bearings of all the engines. These may be divided into gravity and pressure systems. In a gravity system the oil is pumped from a tank in the basement to a tank overhead, from which it runs by gravity to the various lubricators on the engine. Such piping around the engine must be ornamental in character and very well done or else it will present a bad appearance. It is usually made of nickel-plated iron piping and fittings, using bends instead of elbows wherever practicable. Brass piping should not be used on account of corrosion and the consequent stoppage of the pipes. The pressure system of supplying oil is the same, with the exception that air pressure is used to force the oil through the pipes instead of gravity. In both systems a series of drain pipes carries the excess of oil back to an oil filter and purifier located in the basement, from which it is pumped back and used over again.

In stations located in places where coal cannot be conveniently handled and oil is burned under the boilers, a complete system of pipes is necessary to supply this oil. Large storage tanks are located at some point accessible to the street, and into these the oil is delivered by wagons or from tank cars. From these tanks the oil is pumped to pressure tanks located in the boiler room, and thence piped to each boiler. The fuel oil is introduced in a small jet, in the middle of a steam jet, by means of which it is separated into finely divided parti-

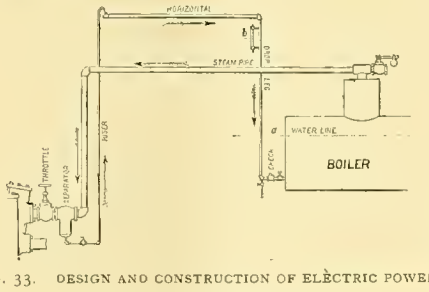

FIG. 33. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LOOP SYSTEM.

cles—the best possible condition for producing a flame of intense heat.

[In the next succeeding lecture the "Connections Between Engines and Generators" are taken up.]

The company backing the Lyons & Sodus Bay (N. Y.) electric railroad has applied to the trustees of Lyons for consent to construct and operate a surface railway upon Geneva, Phelps, Broad and Water streets. It is possible that a combination will be effected with the Fall Brook Railroad company for the hauling of coal, it being the intention of the projectors to so construct the roadbed that steam trains may be successfully operated thereon. The incorporators are George W. Knowles, William S Gavitt, Daniel Moran, James W. Putnam, W. H. Baltzel, F. W. Chamberlain, H. F. Zimmerlein, Richard F. Forgham, A. L. Hoffman, O. F. Thomas, J. F. Gueuthner, W. H. Egan, George Raukert, G. W. Hattler, Charles T. Ennis, B. Hammond, E. W. Hamm, S. C. Redgrove, V. R. Howell, M. C. Taylor, W. Van Camp, George H. Baltzel, C. R. Sherwood and J. S. Jordan.

Messrs. Insull and McDonald to Manufacture Incandescent Lamps.

Negotiations have been pending for the purchase of the incandescent lamp patents, factory and equipment of the Adams-Bagnall Electric company of Cleveland by Samuel Insull of the Chicago Edison company and R. T. McDonald of the Fort Wayne Electric corporation, and it is now announced that the deal has been practically settled, although actual transfer of the property has not yet been made. Details of management and the policy of the new owners of the plant will not be made public until the sale has been consummated. It may be stated, however, that the new concern will be controlled absolutely by Messrs. Insull and McDonald, and that the business will be carried on after they assume possession upon a much larger scale than heretofore.

This action on the part of Messrs. Insull and McDonald indicates that the incandescent lamp trust has not secured absolute control of this field. It is accepted as evidence of this fact that men of experience and discernment see an opportunity for the development of a large business where a satisfactory lamp can be supplied at a reasonable figure. Messrs. Insull and McDonald have had many years' experience in the electrical business and they are thoroughly familiar with the trade. That their action in entering the lamp business at this time has not been taken without mature consideration goes without saying among those acquainted with the business methods of these gentlemen.

Proposed Reduction in Street Railway Fare.

The movement for a reduced rate of street railway fare seems to be extending and gaining followers of influ-

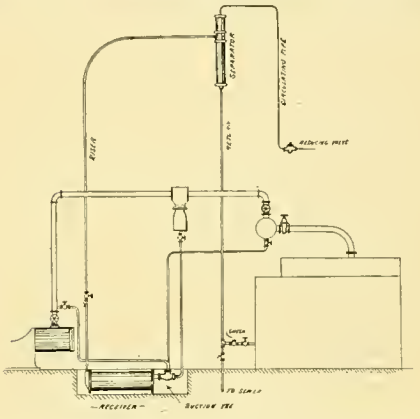

FIG. 34. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—GRAVITY RETURN SYSTEM.

ence and ability. An arrangement has been made by which the efforts of several cities will be united, with the view of eventually making the question of national interest. A dispatch from Cleveland says:

Mayor McKinon has received a communication from Boston asking the co-operation of Cleveland in collecting facts and figures on the three-cent car fare movement. In Boston the movement is being conducted by a citizens' committee, of which Robert Treat Paine, Jr., is president, William L. Rutan treasurer, and Charles M. Cox secretary. Among the vice-presidents are Dr. Edward Everett Hale, Thomas Wentworth Higginson, Robert Treat Paine, Sr., and Josiah Quincy. There are committees on publication, on public meetings, and on petitions, and the movement, in every respect, is being very effectively and systematically conducted. The appeal of Boston to Cleveland to strike hands with her in this matter is only the first step toward a union of all the great cities of the country in the cause of lower street car fares, so that in the end the movement will become national in its scope and character. From now on Cleveland and Boston will act in close unison in the work, and a constant correspondence will be kept up between them. The formation of a citizens' committee in Cleveland of the same character as that in Boston is probable.

The following dispatch from Cincinnati will be of unusual interest at this time on account of the movement:

The Main street electric line, running cars to the Zoo and operating the Mount Auburn incline, made a move in the way of cheaper street car fares on May 8th which promises a revolution. The line will charge only three cents fare between five and seven o'clock a. m. and five and seven o'clock p. m. The road is the only one in the city not owned by the Consolidated company.

In Chicago the advocates of similar action have met several reverses, but they are persisting in their efforts and they are greatly encouraged by their recent victory in connection with the Humphrey bills.

Western Electrician.

EVERY SATURDAY.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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WHEN the independent telephone companies determine upon a line of action to be followed in fighting the Bell interests, it is anticipated that the old company will find that its former efforts in patent litigation were but child's play as compared with the more serious occupation of fighting a combined and powerful organization of vigorous enterprises. The meeting of independent telephone exchanges called for next week to formulate plans should be productive of good results.

ATTENTION is directed to the plans of the American Institute of Electrical Engineers, which will hold its general meeting this year at the home of the late Moses G. Farmer. It is the purpose of the organization to honor the memory of this pioneer who did so much to promote electrical interests. This is certainly a praiseworthy object and should receive the earnest support of every member of the organization. The institute owes a debt of gratitude to the memory of Prof. Farmer because of his valuable aid in its early days. This meeting will afford the organization an excellent opportunity to show its appreciation.

WE extend to our Canadian friends congratulations upon the prospect of an interesting and profitable meeting of their electrical association at Niagara Falls next month. They have shown commendable enterprise and zeal in promoting the interests of their organization, and their loyalty to it is now beginning to bear good fruit. The association is growing constantly, we are informed, and its influence is increasing at a much greater rate than its membership. It appears to be a conservative body of business men and engineers devoted to the electrical industry, and its record indicates that it is deserving of the respect and esteem in which it is held by the public at large. As long as it continues on these lines it is assured of success.

THE origin of the ordinance introduced into the Chicago City Council looking to the purchase of the street railways of Chicago by the city makes it impossible that this measure be seriously considered. To say nothing of the pecuniary and constitutional objections, the city government has yet to demonstrate its ability to run a street railroad, and with the advocacy of the plan entrusted to the men supporting the present measure, it is not to be presumed that any rational being would support the movement. There are grave doubts whether the affairs of any single department now in control of political bosses would bear comparison with the business of any private concern of good reputation as to success in management.

STREET railway men will be interested in the announcement that P. F. Sullivan of Lowell, Mass., has consented to prepare a paper upon "Municipal Ownership" for the Niagara Falls meeting of the American Street Railway association. Mr. Sullivan has made a careful study of this subject in European cities, as well as in this country, and he is familiar with the conditions that prevail here and abroad. His pamphlet, entitled "Comparison of Street Railway Conditions and Methods in Europe and the United States," is unquestionably the strongest argument that has yet been made for the owners of these properties, and those who have read the document will feel that the subject of "Municipal Ownership" could not have been delegated to better hands.

WHEN corporations enjoying valuable franchises from cities appreciate the privileges they have been granted and show it by treating the public with civility and furnishing adequate service, they will merit a continuance of public favor, but they cannot hope to disregard the rights of the public and constantly displease their patrons without incurring hostility. Every corporation of this class, whether operating street railways, electric lighting plants or similar enterprise, finds itself at some time obliged to ask additional favors, no matter how well it may be established. It is at such times that public opinion asserts itself, and, as in the case of the Humphrey bills just defeated in the Illinois Legislature, the people visit their displeasure for offenses long since committed. The short-sighted policy that governed the Chicago street railway companies for many years is now bearing fruit, and if the value of these properties depreciate because of the failure to secure the desired legislation, the corporations themselves, as we have pointed out, are alone to blame.

"CAN the operation of a street railway car, painted a conspicuously bright and attractive color, along a public street, causing fright to a horse, with injury resulting therefrom, constitute negligence on the part of the street railway company, and render it answerable for injuries resulting from such cause?"

Strange though it may appear and unusual as the proceeding must be admitted to be, this question is propounded by the Court of Errors and Appeals of New Jersey in the course of its review of an action against the Consolidated Traction company, without any attempt whatever to present a solution of the problem. Whatever the technical determination of the question may be, it seems that calm judgment would dictate a course on the part of the street railway company that would prevent the recurrence of such an accident. It is desirable from every viewpoint that the street cars in all cities shall be kept clean and attractive, and to do this it is necessary that they shall be brightly painted, but it is not desirable that the color adopted shall be of such a startling character as to frighten horses. A standard dictated by common sense would be acceptable alike to the street railway companies of the country and the communities which they serve.

THE news that comes from Ottawa, Ont., to the effect that a bill of much importance to the Canadian Power company has been reported adversely is interesting, inasmuch as the Ontario government has only recently submitted to the Court of Appeals several questions relating to the rights of the Canadian Power company and the Canadian Niagara Power company. The position of both of these corporations was clearly stated in the WESTERN ELECTRICIAN of May 8th. Each feels that it has power rights in Victoria Park at Niagara Falls, on the Canadian side, and one claims exclusive privileges. Whatever rights the Canadian Power company has were granted by the Dominion government, while the franchise held by the Canadian Niagara Power company was approved by the Ontario government, which has full control of Victoria Park. It is most significant, it would appear, that on behalf of the attorney-general of Ontario, W. Irving of Toronto appeared at Ottawa and opposed the Canadian Power company's bill before the standing committee on miscellaneous private bills. The bill proposes to empower the company to cut a canal through Victoria Park to obtain 15,000 horse power. It asks that the work be declared one for the general benefit of Canada. Mr. Irving took the position that it was a purely provincia matter. Several changes were made in the bill, practically obliterating the main allegations in the preamble clause, and, finally, the bill was reported adversely.

"How and What to Study," is the subject of a very interesting and instructive paper by Prof. Charles H. Benjamin, addressed to young mechanics who have ambition to improve their condition and make their services more valuable by reason of their increased knowledge. He contends, first of all, that it pays the mechanic to study if he direct his efforts in the right direction. A true understanding of the principles of mechanics and machine design, it is pointed out, will make a workman more independent and worth more to his employers in dollars and cents, a fact they will not be slow to recognize. Attendance upon a regular course in evening school is advisable where practicable, otherwise home study must be adopted. With a common school knowledge of arithmetic it is believed that a short course in elementary mechanism, followed by the study of algebra, elementary geometry and plane trigonometry, will enable a seeker after knowledge to get a fair start, and, it is believed, he can then pursue his study of mechanics and mathemathics together, making one illustrate the other. Then the application of the knowledge thus gained to the work in which he is engaged during the day will confirm and stimulate the student's interest in his books. He is advised to look about him in the shop and see what he can find of levers and cranks, gears and cams, to illustrate the principles laid down in the books. If he sees a movement that interests him he is directed to find it in the text-book, or at least something like it. At first it is anticipated that he may find it dull work, but as he begins to get a glimmering of what it is all about he will get new courage and interest, and after that the road will grow easier every day. When he has mastered the mechanism and the mathematics which that implies he will have made a good start on the high-road to a mechanical education. Drawing is, of course, a valuable feature of mechanical training, but, as the writer remarks, "it is of little use to be able to make a nice drawing unless you know what to draw and why." The motive for this study may be summed up as follows: There are many things in machinery which the beginner does not understand, although he wishes to be familiar with them. Mechanism and applied mechanics tell the reason of these things. Mathematics is simply a convenient tool with which to work the problems. Drawing is another convenient tool as an aid in expressing to others the ideas which we wish to convey.

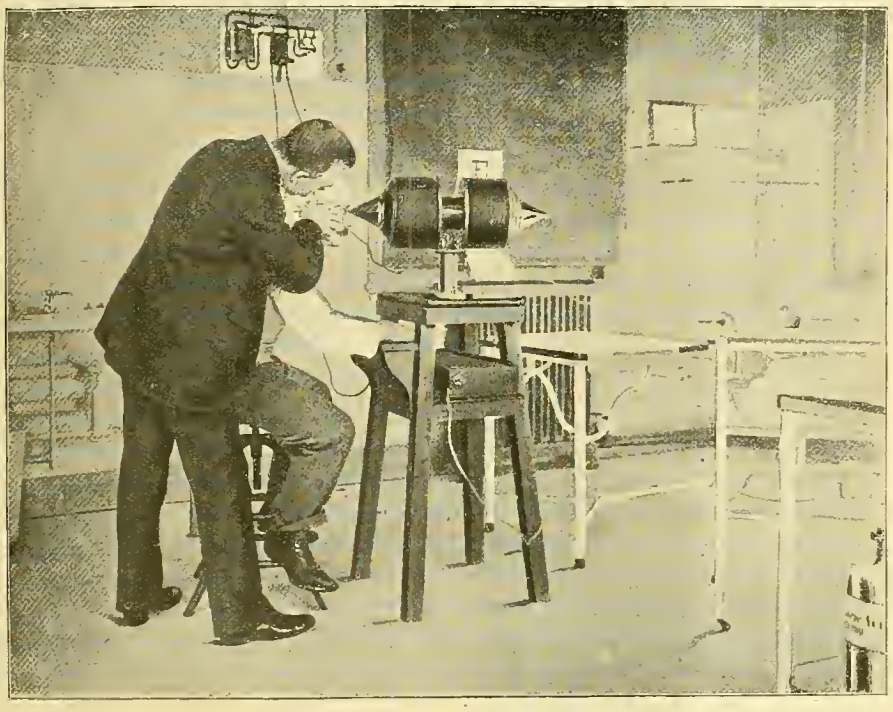
But in all cases the problems and the ideas come from every-day work, and success will depend upon the close connection which the student keeps at all times between his acquired knowledge and his practical work. Such a course as that outlined by Prof. Benjamin requires constant application and considerable hard work, but there can be no doubt that the knowledge acquired will amply justify the labor and study devoted to it, and that it will enhance the value of the services of the student correspondingly.

Large Electro-magnet for Eye Surgery.

One useful application of the electro-magnet is in locating or extractiog particles of iron or steel lodged in the eye. The simplicity and utility of this plan are obvious, and it is found to be of real value to surgeons. The illustration shows the apparatus installed in one of the operating rooms of the New York Eye and Ear Infirmary to take advantage of the attractive power of the electro-magnet. The soft iron core of the large magnet here used is about two feet long and three inches in diameter, pointed at each end, as shown. The winding is disposed on spools in the manner indicated in the picture aod is supplied with current from the house mains. The whole magnet rests on a stand and is arranged to turn easily at the touch of a hand. The practical value of the magnetic appliances is described in the *Illustrated American*, from which the picture is reproduced, by George B. Waldron:

Suppose, as often happens, a worker in iron or steel is struck in the eye by a fioe splinter of metal from a machine. The intense pain which follows is as nothing in comparison with the immioent danger of losing the eye. The case requires the attention of the most skillful specialist. So the sufferer is taken at once to the hospital.

The first thing to do is to locate the piece of metal.



LARGE ELECTRO-MAGNET FOR EYE SURGERY.

The instrument used is a small needle highly magnetized with electricity. If the splinter is on the surface of the eye it will cling to this needle and can be easily removed.

But it may have been hurled with such force as to have become imbedded in the eye itself. The white portion of the eye which surrounds the iris or colored ring is composed of tough muscles, which cao be penetrated with only the greatest difficulty. If the iron or steel particle becomes imbedded in this muscular tissue it will not yield to the magnetic needle.

Now comes the use of the large magnet. This instrument has a drawing force of 16 pounds. As the eye of the patient is pressed toward its point the subtle magnetic power begins to draw upon the splinter. The metal, struggling for release, bulges the eye from the socket. If not too deeply imbedded the splinter will yield to the force and, leaving the eye, become attached to the point of the magoet.

But, as only too often occurs, the metal may strike with such force as to perforate the coating and drop down into the cavity of the eyeball. Especially is this the case when it passes through the iris or the pupil. One instance was mentioned by the attendants at the hospital of a splinter which passed entirely through the eye and lodged in the coating on the other side of the ball.

Applied to the eye, the big magoet will reveal with accuracy to the skilled sight of the physician the position of the troublesome particle. Knowing this, he can remove it by an operation. Only in the most desperate cases need loss of sight follow.

National Electric Light Association.

The Trunk Line association, the New England Passenger association, the Central Passenger association and the Southern Passenger association have made a rate of a fare and one-third, on the certificate plan, from all points in their territory to Niagara Falls and return for delegates to the twentieth convention of the National Electric Light association, to be held at Niagara Falls, beginning June 8th and lasting three days. In purchasing tickets members are instructed to ask for a certificate, which will eotitle the purchaser to be returned at one-third the regular fare.

The arrangement for a special train from New York has been a somewhat perplexiog question, owiog to the desire that members should eajoy the best possible service at the lowest possible rate. After long and continuous negotiations, a most satisfactory arrangement has been made with the West Shore Railroad company to run a special train of vestibuled parlor, library and dining cars, leaving New York at the foot of Forty-second street, North River, at 10:15 A. M., and the foot of Franklin street 10 A. M., Monday, June 7th. Tickets to return will be accepted upon the West Shore Railroad or New York Central & Hudson River railroad, thus enabling the delegates who take this train to enjoy the view of both sides of the river if they so desire. The daylight run was decided upon owing to an almost unanimous request on the part of members, on account of the large number of ladies who propose attending the meetiog. Tickets and parlor car accommodation can be had by applying to C. O. Baker, Jr., 136 Liberty street, New York, master of transportation.

Canadian Electrical Association.

Unusual preparatioos are being made for the annual meeting of the Canadian Electrical association at Niagara Falls, Ont., June 2d. The convention will last three days, and the visitors will be entertained by the local interests. The list of papers to be presented includes the following:

"Day Loads for Central Stations and How to Increase Them," J. A. Kammerer, Toronto.

"Submarine Cables—Dealiog More Especially with the Actual Experience in Cable Laying and Maintenance in This Country," D. H. Keeley, Ottawa.

"Determination of the Heating Power and Steam-producing Value of Coal from a Preliminary Examination," William Thompson, Montreal.

"Water-driven Plants," John Murphy, Ottawa.

"The Commercial Aspect of Electric Railways," C. E. A. Carr, London, Ont.

"Accumulators: Their Application to Central Station Lighting and Power," W. A. Johnson, Toronto.

"Why Some Lightiag Plants Do Not Pay," F. C. Armstrong, Toronto.

"Steam End of an Electric Plant," A. M. Wickens, Toronto.

By special invitation of the management of the Buffalo & Niagara Fall Electric Railway company, there will be an excursion on Wednesday evening by specialelectric cars from Niagara Falls, N. Y., to Buffalo, where a visit of inspection to the Buffalo railway power house will be the special feature. On Thursday evening the annual banquet at the Dufferin Cafe will be held. The last day will be devoted entirely to social features. The following programme is announced:

9 A. M.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park & River railway to Queenston.

9:45 A. M.—Cross Niagara River by Niagara Navigation company's steamer to Lewiston, N. Y.

10 A. M.—Leave Lewiston by special cars on the celebrated Gorge electric railway, reaching Niagara Falls at 10:45.

11 A. M.—Visit of inspection to hydraulic power house.

11:30 A. M.—Descend by inclioe railway and take steamer Maid of the Mist for a trip to the foot of the cataract, landing on Canadian side.

1:30 P. M.—Cross suspension bridge.

2 P. M.—Inspection of the power house and works of the Cataract Construction company.

3. P. M.—Visits to various electro-chemical works.

American Street Railway Association.

A special announcement, dealing principally with the supply men's interest in the American Street Railway association, has been issued by Secretary Penington. The exhibits form such an important part of the gatherings, it is explained, that the executive committee, in making arraogements for the meetiog, has been mindful of these wide-awake allies of the organization and zealous in providing for their convenience and accommodation. An executive session at Niagara Falls decided that a commodious hall be erected io the ceoter of the city and very near all the hotels. The steam railroad tracks are now within 200 feet of the building, and the committee secured an agreement to have these tracks extended directly to the building, thus saviog to the exhibitors all charges for cartage. A side-track will be laid in front of the hall for cars, sweepers, etc.

As the convention will be held on the second floor of the exhibition hall and all stairways lead up from the inside, the attention of all delegates and visitors will be called to the exhibits. The entire hall is to be lighted and heated during the entire presence of the exhibits. Written agreements have been secured that all the hotels will be kept open and rooms can he had at rates varying from $1.50 to $4.50 per day.

The income from the sale of space will go to the American Street Railway association. The executive committee of the association has fixed the price at 10 cents per square foot, and ruled that no space of less than 100 square feet will be assigned, but applicants may have as many multiples of this quantity as they may wish, all in one body. Payment for space should be made to T. C. Penington, 2020 State street, Chicago, on or before October 1, 1897. Application for space should be made to H. W. Beardsley, chairman committee on exhibits, Niagara Falls, New York. Space must be applied for by September 1st. Assignmeots will be made as promptly as possible after that date and exhibitors notified of their location. Exhibits of like character will be grouped together, and space will be assigned in the order of application.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, October 18th, which is the eveoing prior to the opening of the convention. Possession of the hall can be had on Monday, October 11th, thus giving ample time for preparation. Watchmen will be in charge of the premises so that exhibits will be safe.

If the supply-men so desire, and will designate one of their own number who will be willing to go to Niagara Falls at some short time previous to the meeting, and whose necessary expenses they will defray, the executive committee will invest him with the requisite authority to supervise the reception and placing of displays. He can arrange with local carpenters, lumbermen, etc., to the effect that there may be no unfair charges for services or material that may be oecessary in arranging exhibits.

The correspondeot for the WESTERN ELECTRICIAN at Niagara Falls sends the following details concerning the arrangements for the meeting: "The Chamber of Commerce of Niagara Falls has finally made what are very likely to prove very satisfactory arrangements for a convention hall. Instead of erecting a temporary structure it has purchased the former armory of the Forty-second Separate Company from the Niagara county Board of Supervisors, and will add to it as demand makes necessary. This building is located on Walnut avenue within two minutes' walk of the Niagara Falls & Suspension Bridge street railway line and within less than 10 minutes' ride from any hotel in the city. Its location is on the highest land in Niagara county, and about midway between the two business sections of the city. Its pres-

ent dimensions are 99 by 132 feet and to this will be added at once an addition sufficiently large to make the building square, or 132 by 132 feet. The front of the building is two stories high, and on the second floor the building will be remodeled in order to make a convention hall capable of holding and seating 300 people. It is intended that for the convention of the American Street Railway association in October next the entire ground floor shall be given up for exhibition purposes. In order to provide ready facilities for the transfer of shipments to and from the railroads centering at the Falls, it is proposed to make temporary connections with the Erie road, while shipments arriving over the New York Central will be transferred over the Niagara Falls & Suspension Bridge street railway at night after the regular travel has ceased. For this purpose a branch of the trolley line will be extended to the doors of the convention hall. At present the building is steam heated, and there is little doubt that all will be well pleased with the condition of affairs during the convention. The building is in a fine state of preservation, and far superior to the convention halls of many larger cities. The city was enabled to purchase it only from the fact that the state had built the militia company a new brick armory. The sides of the exhibit room are 16 feet high, from which point the trussed, open timbered roof springs. The rooms are all well lighted and there is a commodious basement."

Electricity in Dredging for Gold.

An interesting installation is in operation at Grasshopper Creek, Bannock, Mont., in which an electrically operated gold dredging machine is employed. This district was formerly noted throughout the country for its output in the early days of placer mining in Montana. The dredge is said to be the first of its kind operated by electricity. Work on the present plant was begun in 1895 and the system has been in satisfactory working order some time, it is claimed.

Water was brought from a river 60 miles away, through a line of pipe which terminates in the vicinity of the dredge. Here it drives a turbine of 200 horse power capacity direct-connected to a General Electric company's generator. The current is carried to the dredge, where it is used to drive two motors, each of 70 horse power. The power of the first is used for pumping and flushing and for clearing the gravel from the gold. That of the second is used to hoist the dredging buckets, which are set on an endless chain. The balance of the capacity of the generator is used for lighting the dredge and the shore. Each bucket has a capacity of about one bushel, and as it reaches the top it dumps its contents into a hopper, whence it is raised 25 feet and dumped into a sluice, where it is washed. The sluices are charged with quicksilver to retain the gold, and the debris is carried away by the strong flow of water furnished by the pump mentioned. In the accompanying illustrations, which are reproduced from the *Engineering and Mining Journal*, the dredge is shown at work. The trestle on which the sluice is supported is shown in Fig. 1, while Fig. 2 shows a general view of the plant and its surroundings. The pipe line through which water is carried to the power house may be seen on the side of the hill.

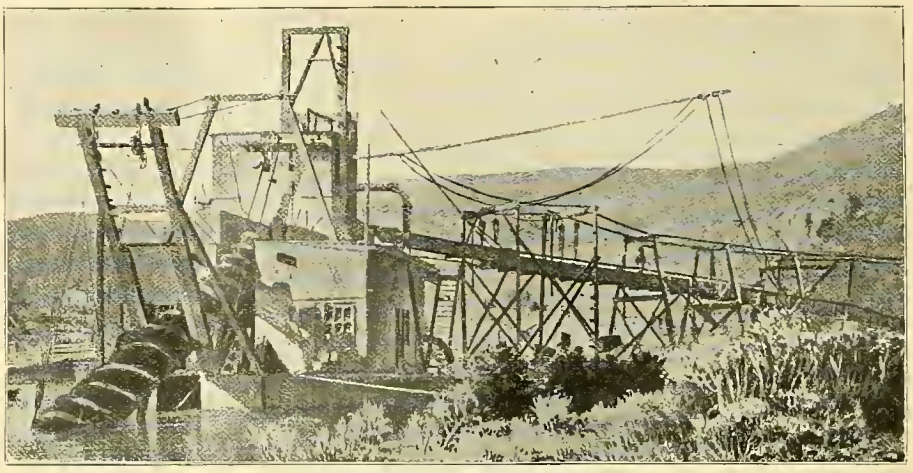


FIG 1. ELECTRICITY IN DREDGING FOR GOLD.

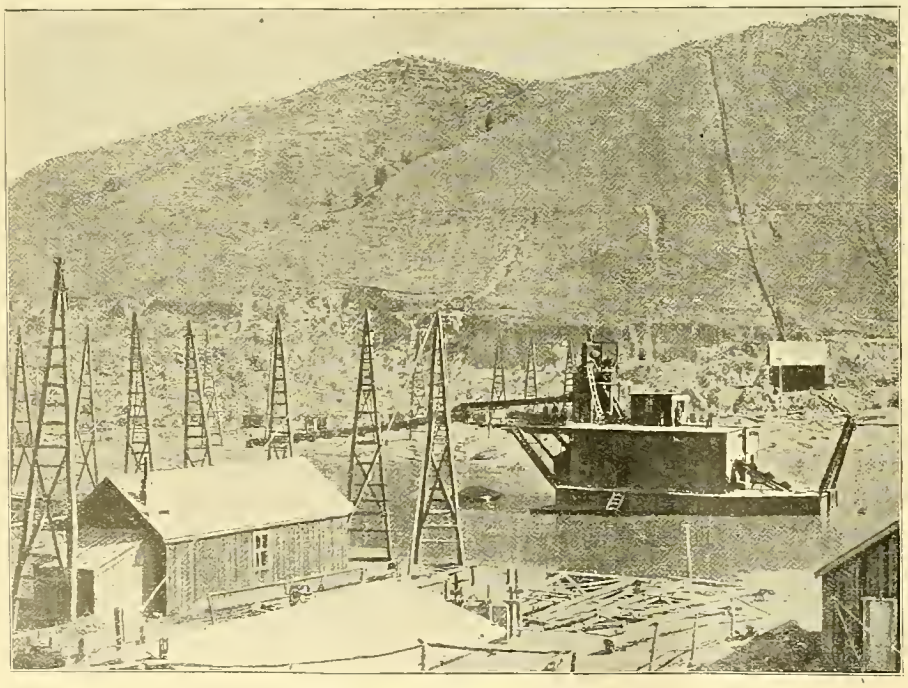


FIG. 2. ELECTRICITY IN DREDGING FOR GOLD.

It is said that very satisfactory results have been obtained, and that by means of this process gold to the amount of more than $500,000 has been recovered during the past year. This success has warranted the purchase of another dredge similarly equipped by the General Electric company.

Identification Through Telegraph Blank.

An idea of the thorough and systematic methods employed by the large telegraph companies in filing and recording all messages entrusted to them for transmission and delivery may be gained from the experience of the New York police in tracing, by means of a scrap of telegraph blank found on the body of the Central Park suicide last week, the unfortunate woman's movements immediately before her rash act, and disclosing the motive of her deed. The story, as told by the *Sun*, is as follows:

The clue which led to the identification of the suicide was the little scrap of a Postal telegram blank which was found upon her person carefully wrapped about a single violet. The only marks upon the paper were the number 59 and the check letters of the sending and receiving operators. When Superintendent Bradley of the Postal Telegraph-cable company received the scrap from Coroner Hoeber, he immediately set seven men to work to trace the telegram. Almost any large office, including several branch offices in this city and Brooklyn, transmits as many as 59 messages every day; so the number was of little use for tracing purposes until the sending and receiving offices should have been determined. The men, therefore, went to work first upon the check marks. These were much faded by the action of the water, but that of the receiving operator was made out with the aid of a magnifying glass to be Tb. This is an uncommon signature, and there is an operator in the main office who uses it. This narrowed the field somewhat, but the work was prolonged because of the impression gained, from some of the other papers found upon the body, that St. Louis was one of the points concerned. The check of the receiving operator was illegible, because part of it had been torn off, but the writing that remained was found to be the first part of the letter F. After nearly 24 hours' work, and the examination of hundreds of telegrams numbered 59, one was found sent by Tb to Fu, a receiving operator in Brooklyn. This was addressed to Mrs. Ethel Marie Reis, 42 Columbia Heights. Mr. Bradley thought it likely that this was the missing message. He went to Coroner Hoeber's office and told him what had been done. The rules of the telegraph company prohibit the publication of any telegram sent over its lines, so Mr. Bradley refused to give a copy to Coroner Hoeber. He also declined to divulge the name of the sender. He gave the coroner a sheet of paper on which was written simply Mrs. Reis' name and address, and he exacted a promise that the coroner would not reveal even this unless the suicide should be identified as Mrs. Reis. Coroner Hoeber sent a detective to the address, and when he had made reasonably sure that the identification was correct the name and address were made public.

Bellevue Electric Light Plant.

Reports have been received from Z. G. Houch, city electrician of Bellevue, Iowa, representing the city lighting plant to be in flourishing condition. This does not agree with the statements of others who claim to be familiar with the affairs of the city lighting plant. Mr. Houch says:

We have a 1,000 light outfit, and it is surprising, in a town of this population, the way in which residents are taking lights. One inducement is $1 per 1,000 lamp-hours. We are running at full capacity, and there is every indication that bids will soon be considered for the erection of an 80 horse power boiler and engine, and a 50 light arc dynamo.

The plant is being run in connection with the waterworks and since the first of the year has been run all night.

Mr. Houch submits the report for December, in which he claims that the street lighting costs the city nothing and that there is actually a gain of $78.79. According to the same statement, the plant comprises one Fort Wayne 1,000 light alternator, 12 1,200-candle power arc lamps and 49 32-candle power incandescent lamps for street lighting. There are also 526 16-candle power lamps in commercial houses and 230 16-candle power lamps placed in residences. The commercial lights are being supplied at 60 cents per light per month. Those having meters pay one-half cent per lamp-hour for 16 candle power lamps. The official statement of expenses and receipts is given as follows: Five hundred and twenty six commercial lights at 60 cents, $315.60; meter collections, $61.72; total receipts, $377.32. Total operating expenses, $298.53; net earnings of plant, $7.879.

The following statement is made by a gentleman who claims to have examined the conditions that obtain in Bellevue:

Coal is worth $2.65 per ton in the bin at the power station, and the consumption of the city plant is 10 tons per month Besides this, it burns 30 cords of wood each month, which costs $3 per cord. Labor costs the city $85 per month. The city's investment in the lighting plant amounts to about $8,000, from which you can easily calculate the amount to count on for depreciation, interest, insurance, etc., at the usual rates. The income from the plant does not exceed $200 per month, and the charge which the city makes against itself on its books for street lighting (12 arc and 50 incandescent lamps of 32 candle power) is $75. You can therefore easily see that the plant is not in a very flourishing condition.

Telephone Situation.

The decision of the Supreme Court of the United States on the Berliner patent in the government suit against the American Bell Telephone company has not yet been printed, and as the court ordered that no stenographic report of Justice Brewer's statement be made, it will be necessary to await the official publication of the decision and opinion to get further information of the grounds upon which the decision was based.

The anti-Bell interests, however, are preparing to fight any attempt to sustain the Berliner patent upon its merits, and they are also taking steps to inform all who may be interested in opposition companies, whether as manufacturers or owners of exchanges, of the effect of the Berliner decision and the telephone situation today. It is pointed out that the Berliner patent is in no way declared valid, but on the contrary the declaration is that infringers may question its validity. The court has even declined to decide the question as to whether or not the 1880 patent for the identical matter used as a receiver, instead of a transmitter, anticipates this patent. It will be remembered that Judge Carpenter, in the Circuit Court, held that the 1880 patent did anticipate the patent in suit, and this latter patent was therefore invalid under the ruling of Miller vs. Eagle Manufacturing company (151 U. S., 186). The United States Circuit Court of Appeals (68 Fed. Rep., 542) held that this was a question open to an infringer and was therefore not a ground for the cancellation of the patent by a suit in equity. The effect of the Supreme Court decision is to affirm this view. Therefore, all the questions which were discussed in the Berliner case are still open with the exception of the question of fraudulent delay in the Patent Office. These include:

First—The contention that the application as filed June 4, 1877, did not describe the constant contact transmitter covered by the patent as issued.

Second—Irregularities of procedure in the Patent Office, aside from questions of delay.

Third—The anticipation of the Berliner patent by Alexander Graham Bell in his patent of March 7, 1876, which patent disclosed and described the process and apparatus of the Berliner patent.

Fourth—The contention that the Berliner patent of November 2, 1880, is for the same invention as the patent in suit.

Fifth—The fact not discussed in the government suit, or in any way alluded to, but known to all who are well informed in the telephone art, that Berliner was anticipated by the work of Thomas A. Edison.

Sixth—The relation of foreign patents to the Berliner patent.

The judicial utterances upon these questions consist of Judge Carpenter's decision that the Berliner patent is void, because of the patent of November 2, 1880, and the decision of the board of examiners that new matter was inserted in the patent as issued which was not embraced in the original application.

Even should the patent be finally sustained, there is the great question as to whether any particular form of transmitter which may at present be used would infringe the Berliner patent. Berliner himself, in his patent, disclaims the broad invention of varying the resistance of an electric circuit in a manner to correspond to the variation of the sound waves. Eminent authorities have considered that good transmitters at present in use do not infringe the Berliner patent. Without doubt other transmitters capable of producing good commercial results will be devised if required by necessity, which will in no wise infringe the claims of the Berliner patent.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

A. T. Presson, who is putting in a telephone system at Hudson, Wis., is taking steps to secure connection and possibly an exchange in New Richmond and Cylon.

The Dakota Central Telephone company of Aberdeen, S. D., is preparing to extend a line from Groton to Ortonville, Minn.

The Mutual Telephone company of Des Moines, Iowa, expects to have 500 instruments working by June 1st.

The Union Electric Telephone company will extend a line from Zumbrota, Minn., to Red Wing, Minn., soon.

T. F. Robinson contemplates putting in a telephone exchange at Marshall, Minn.

The decision in the Berliner patent case has not dismayed the Mississippi Valley Telephone company in its application for a franchise in Minneapolis. Its representative said that the company would look after the patent part if the council would furnish the franchise.

E. H. Martin, president of the Iowa Telephone association, said in connection with the Berliner patent decision that it would have no effect on the independent companies of the state. The object of the association of which he is president is to fight the Bell interests and to protect its own unitedly.

The Iowa Telephone company's headquarters are to be removed to Des Moines, Iowa, from Davenport at once. Important additions to the toll lines have been decided upon also.

The Clearfield & Mount Ayr Telephone company is stringing a wire between Murray and Lorimore.

The Spokane & British Columbia Telephone & Telegraph company expects to have telephone connection between Spokane, Wash., and Rossland, B. C., by June 1st.

The Fountain City Telephone company of Fountain City, Wis., is expanding its system into an exchange with about 30 subscribers.

A telephone line is being built from Marshfield, Wis., to Rozellville.

Sioux City, Iowa, will have long-distance connection by the American Telephone & Telegraph company's system with Minneapolis and St. Paul in two months and with the principal eastern cities by August. The company's line to Chicago from Minneapolis has been begun and will be pushed.

Independent Telephone Exchanges to Organize.

A movement is on foot to organize the independent telephone exchanges of the country to oppose the American Bell Telephone company in any action begun by that corporation to sustain the Berliner patent on its merits. A meeting has been called for May 27th, 28th and 29th, by the Western Telephone Construction company of Chicago, to which all independent exchanges are invited to send representatives for the purpose of considering measures offensive and defensive.

Bell Company Sued.

The Western Telephone Construction company seems to have determined on turning the tables on its old enemy, the American Bell Telephone company, and it has accordingly assumed an aggressive attitude. It has filed bills against the American Bell Telephone company, the Western Electric and other companies whose interests are allied with those of the Bell company, alleging infringement of a patent for a telephone receiver to J. E. Keelyn, No. 581,350, owned by the Western Telephone Construction company. The progress of this suit will be watched with interest.

COMMUNICATIONS.

Supreme Court Decision a Victory for the People.

To the Editor of the WESTERN ELECTRICIAN:

My personal opinion having been asked upon the recent decision of the Supreme Court in the Berliner patent case, I beg to state that I consider it a victory for the people and a defeat for the Bell company. There were four points of contention, any of which might have been a defeat for the Bell company, and only three of which could have been considered a victory for the Bell company in case of favorable action. Upon these three points the Bell attorneys fought with all their vigor against adjudication, indicating their absolute fear of the result. If they had had confidence in it, they would have sought an adjudication upon all of them. If they had had confidence in any one of them, they would have endeavored to take advantage of it by getting a favorable decision. Their whole effort was to prevent a decision upon any other point than that of alleging fraud upon their part in delaying the issue of the patent. They gained upon this point, but lost upon the three others, for there is hardly a doubt that they could have had an adjudication by the Court of Appeals upon the other points, if they had not fought it so severely.

Therefore, their fears are substantiated by facts, and taken, all in all, the farcical litigation between the Bell people and the government is in fact a victory for the people.

J. E. KEELYN.

Chicago, May 17, 1897.

The Berliner Patent and Bell Royalties.

To the Editor of the WESTERN ELECTRICIAN:

While the public is very generally interested, and in certain quarters much exercised, over the recent Supreme Court decision on the Berliner patent of 1891, I note little, if any, comment relating to its most prominent phase. The question is not what will be done in the way of legal action against companies which are manufacturing and selling battery transmitters, but its incalculable value to the American Bell Telephone company in the matter of royalties. It is quite evident that an adverse decision must have interfered with the collection of royalties, and from the recent report showing nearly 800,000 telephones in operation in this country, it is not difficult to figure out a tremendous loss in revenues to the American Bell company's stockholders, not only in actual receipts, but a depression in some part of the value of Bell telephone capital stock. In view of this fact, I doubt very much if the Bell company will ever force an issue, if it can be avoided, in a further decision on the Berliner patent in any suit based on merit; the company has too much at stake and can ill afford to lose the advantage it has gained through the decision of the Supreme Court just rendered, which is therefore of great value to the American Bell Telepone company, regardless of competitive conditions.

J. J. NATE.

Madison, Wis., May 14, 1897.

Berliner Decision a Victory for Independent Companies.

To the Editor of the WESTERN ELECTRICIAN:

In response to your inquiry as to the effect of the Berliner decision on our business and the public generally, it may be said that for our part we are jubilant over this decision, and we consider it a signal victory for the opposition companies for the following reasons, which certainly appeal to common sense, viz.:

The Supreme Court refused to consider the question of validity of the patents in view of the 1880 Berliner patent and other defenses, thus compelling the Bell company to settle the vital questions relating to anticipation by a protracted infringement suit which cannot be settled for many years. The only court (the United States Circuit Court presided over by Judge Carpenter of Boston) which passed upon the questions that will arise in the infringement suit, decided against the Bell company, and it is reasonable to suppose that any other court considering the same questions will do the same thing.

The United States Circuit Court of Appeals and the Supreme Court of the United States hold that these questions which will arise in an infringement suit could not properly be considered in a suit founded on fraud.

The *Chicago Record*, in an editorial of May 11th, sums up the situation better than we can do it as follows: "The policy of the Bell company in evading a decision upon all the grounds of invalidity that had been raised, and thus throwing away an opportunity to gain a clear title to the invention, if it had a right to it, seems to lend color to the claim of the independent telephone companies that the Bell company has really little faith in this patent, and that, instead of securing a judicial decision upon the merits of the case, it proposes to use the Berliner patent and the decision of the United States Supreme Court as a club over weaker corporations. In spite of all the claims that may be made by the American Bell Telephone company and its agents and advocates, the decision of the Supreme Court of the United States is apparently of no practical value in continuing and sustaining the monopoly of the telephone industry."

As to the moral effect of the decision on public business, there is no question that it will be more or less great until the public comes to learn that this is but another cloud which the Bell company has shrewdly thrown over the industry. Nerveless and weak-kneed investors will undoubtedly take alarm for the time being, but this decision gives to those best posted wonderful opportunities to make telephones while the clouds hang low.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY,
F. A. ROSS, General Manager.

Chicago, May 11, 1897.

Proposed Governmental Experiments with Rapid Telegraphing.

Senator Pettigrew of South Dakota has introduced a bill authorizing the postmaster-general to acquire for the use of the United States the right to use any new method of rapid telegraphing by the use of alternating currents, or otherwise, which has been developed by Prof. Crehore and Lieut. Squier, or others. The postmaster-general is also authorized to construct a telegraph line of the best copper wire or other material best suited to the purpose between Washington and New York, for the purpose of experimenting and perfecting the use of rapid telegraphing in the transmission of information and correspondence between individuals. For the purpose of carrying out the provisions of this act there is appropriated the sum of one million dollars.

John C. McKeon, receiver of the Calumet Electric Street Railway company and of the National Bank of Illinois, has filed a petition in the federal court for leave to borrow money to keep the railway running and to make necessary improvements. He made a statement in the petition that he needed $185,000 for immediate use. At his own request the petition was referred to Master of Chancery Bishop to inquire into and to report to the court the condition of the railway and the need of the order to borrow money. In his statement Receiver McKeon says that he has loaned as receiver of the bank to himself as receiver of the railway the sum of $51,423 to meet current obligations and pay-rolls.

Composition and Classification of Arc-lamp Carbons.

An instructive decision has been rendered by the United States general appraisers in the case of Dingelstedt & Co. and others against the ruling of the collector of customs of the port of New York relative to the rate of duty chargeable on merchandise consisting of carbon points, sticks or pencils imported through the port of New York since the enactment of the Wilson bill.

The rate of duty assessed was that provided for in paragraph 86 of that act, for "all articles composed of earthen or mineral substances, not specially provided for in the act, at 35 per centum ad valorem."

Various protests were entered against this rate of duty. One claim was that the carbons should be entitled to free entry under paragraph 443 of the act, as "products or preparations of coal-tar." Another was that they are dutiable directly or by similitude of component material of chief value under section 4 of paragraph 40, which provides for "black, made from bone, ivory or vegetable, under whatever name known, including boneblack and lampblack, dry or ground in oil or water," in both cases at 20 per centum ad valorem. A third ground of protest was based on the assertion that the carbons should be assessed at 40 cents per ton under paragraph 318½ as "coal, bituminous and shale," or at 15 cents per ton under a further provision of the same paragraph; and in the event that it was decided that the product was not dutiable under any of the sections named above, then it was claimed that the duty should be 20 per cent. ad valorem under section 3, as a non-enumerated manufactured article.

In handing down the decision the appraisers stated that carbon points are cylindrical in form, of various sizes, from one-third of one inch to one inch in diameter, 12 to 15 inches long, and molded in the form of a candle. They are solid or cored. Both kinds are generally made of like materials, although the proportions may vary, but a cored carbon is molded with a core composed of a combination so mixed that when finished the core is softer than the surrounding body. These carbons are used in arc lamps as electrodes. A cored point serves for the positive and a solid point for the negative pole with a direct current, while two cored points, or points of like form and composition, are used with an alternating current. Two of such points are fixed in line vertically in the lamp, the base of each being connected with the circuit, while the tops are, by suitable devices, made to touch until the passage of the electric current is established, when they are automatically separated, leaving a little space, not sufficient to break but to retard the passage of the current, thus creating at the poles an intense heat, rendering the points incandescent, oxidizing, vaporizing or consuming their substance, and emitting light. The incandescent points are automatically maintained at a uniform distance from each other by a feeding device until they are nearly consumed. The core is consumed with slightly more rapidity than the shell, thus centralizing the point of greatest incandescence. It is, therefore, evident that carbon points are articles manufactured into forms that adapt themselves for use in a particular place and manner for a special purpose.

The various materials used in the manufacture of carbon points are principally lampblack, natural graphite or plumbago, gas-retort graphite, which is the free carbon taken up and deposited against the top of the retort in the distillation of coal, some qualities of retort coke, the carbon residuum from the distillation of petroleum and coal-tar. Lampblack at the present time is chiefly produced by the combustion of dead oil (a fractionate of tar distilled from bituminous coal), and by the combustion of natural gas. It is also so produced to some extent from animal and vegetable substances.

The solid points are compounded mainly of lampblack and retort graphite, which are powered and made into a dough with fluid coal-tar, and the articles molded therefrom under great pressure. Subsequently the molded articles are exposed for several days to heat approximating 2,000°, by which the body is coked or reduced to a homogeneous mass of carbon. The shell of the cored carbon is similar in composition to the solid rods, but the core is formed from lampblack, sometimes with a slight proportion of graphite, with a binder, and in the finished article is of less density than the surrounding body. An examination of a carbon point will show that in the absence of detailed evidence from the manufacturer as to the exact weights, character, proportions and values of the materials used, and their sources, this information cannot be satisfactorily obtained by a chemical analysis. The following is a statement of the analysis of a cored point:

Soft core, one-sixteenth of the whole carbon:	
Silicon	4.74
Oxide of iron	trace
Alumina	.48
Lime	trace
Magnesia	.14
Alkaline carbonates	5.36
Combustible carbon	89.28
	100.00
Body or shell:	
Combustible carbon	99.92
Iron	.08
Silica	trace
Lime	trace
Magnesia	trace
	100.00
Another analysis shows:	
Carbon	97.90
Ferric oxide	1.80
Traces silica and alumina	.30
	100.00

With the foregoing data the several claims in the protests were passed over by the appraisers, with these conclusions:

First—That these carbon points are finished articles, molded into special forms for use as electrodes in arc-light electric lamps.

Second—That the same are composed of a hard mass of substantially pure carbon produced by subjecting a molded compound of lampblack, retort graphite and coal-tar to great heat for a long period of time; that the substances of said compound were produced or fractionated from bituminous coal by the action of heat, and that the lampblack used exceeded in value either of the other component materials.

Third—That these articles are not coal-tar products or preparations, nor so commercially known.

Fourth—That the material composing the body of these carbon points closely resembles native graphite in material and quality and earthen substances in texture, and that carbon is in fact the chief constituent of coal.

It was therefore held that carbon is an elementary mineral substance (see Encyclopedia Britannica, "Geology," vol. 10, pp. 227-8), and that the merchandise was properly classified for duty directly or by similitude at the rate provided for in paragraph 86 of the Tariff Act of 1894 for articles composed of earthen or mineral substances not specially provided for in the act.

The protests were thus overruled and the collector's decision affirmed in each case.

A Motorman with Good Intentions but Poor Judgment.

Instances have been reported where motormen on electric railway lines have speeded their cars and stopped runaway horses; but the plan is not always successful, as is shown by the following account from Fort Lee, N. J.:

Two men were badly hurt and many other persons shaken up and bruised by an accident to a Bergen County Electric company trolley car at the foot of the Leona Hill. The car, which was an open one, was running from Undercliffe to Leona at the time. As the car was decending the Leona Hill, a runaway horse attached to a buggy, was seen approaching by the motorman. He hurried his car forward to reach the foot of the hill, and thus head of the horse, compelling the animal to make the turn there. The horse otherwise was in danger of continuing in a straight line and running over a declivity.

In his eagerness to reach the curve, the motorman struck too fast a pace, and could not stop the car when he got there. The car jumped the track and ran about 30 feet before it stopped. A. H. Bataille of No. 48 Vanderpool street, Newark, was sitting on the outside end of one of the rear seats. When the car left the track he was thrown from his seat to the road, and sustained severe injuries. His head was badly cut, and one of his legs broken just above the ankle. He was removed to the hospital at Englewood. George Rackett of No. 86 Lawrence street, New York, was also thrown out, but escaped with a badly bruised hip.

There were 32 other passengers on the car when the wheels left the rails. They were thrown out and tumbled from their seats, but no one was seriously hurt. There was considerable excitement at first, as it was thought that many had been severely injured.

The motorman was Joseph Hertz of Hoboken, Louis Brosch of Fort Lee was the conductor. The latter saved himself from being thrown from the car by holding on to one of the brass guard rails at the rear platform. His arm was badly wrenched. The motorman escaped injury. The horse which was the cause of the trouble turned the corner all right, and was caught a short distance beyond.

Chicago Electrical Men's Dinner.

The second dinner of the season was held at the Union League Club on Tuesday evening, May 14th, and was attended by the following representatives of the electrical industry and allied interests of Chicago:

B. J. Arnold,	S. J. Larned,
C. E. Affeld,	W. H. Merrill, Jr.,
F. B. Badt,	William H. McKinlock,
C. D. Crandall,	E. J. Nally,
Louis A. Ferguson,	La Verne W. Noyes,
Dr. Elisha Gray,	John B. O'Hara,
W. L. Githens,	Charles T. Page,
Angus S. Hibbard,	George M. Pullman, Jr.,
C. S. Holt,	C. H. Summers,
W. S. Hine,	L. L. Summers,
Milo G. Kellogg,	F. S. Terry,
W. A. Kreidler.	J. B. Wallace,
W. J. Lloyd,	

The gathering was a very enjoyable event in every respect. Dinner was served in the tower room, the company being seated about a round table that had been tastefully decorated for the occasion. Music was furnished by an orchestra in an adjoining room. After the dinner Dr. Gray called the members to order. His appearance was the signal for a demonstration in which two dozen cow-bells played an important part. Among the speakers of the evening were W. H. Summers, Milo G. Kellogg, W. H. Merrill, F. S. Terry, C. S. Holt, C. D. Crandall, B. J. Arnold, W. A. Kreidler, F. B. Badt, W. S. Hine and J. B. Wallace. Messrs. Hibbard and Hine gave some very enjoyable musical selections. An amusing feature of the evening's entertainment was the reading of a number of telegrams received by members during the dinner. These were in every case marked "C. O. D.," and the charges indicated that the telegraph rates were not in the least affected by competition or business depression. Before the close of the meeting the entire party drank the toast, "Our Departed Friends" in memory of Franklin G. Beach, Merritt C. Bristol and W. B. Somerville.

Altogether, the dinner was most enjoyable, and those who were present expressed the hope that the series would be continued.

Alley "L" Electrical Equipment.

Commenting upon the plans of Frank J. Sprague for the electrical equipment of the Alley "L," Chicago, which were described in the last issue of the Western Electrician, F. B. Badt says:

I beg to call your attention to United States patent No. 552,369, dated December 31, 1895, granted E. G. W. C. Hoffman upon "Means for Operating Electric Railway Vehicles," from which the following quotation is made:

"A further object of the invention is to provide for switching into or out of circuit the electric motors, and also for actuating the motor current reversing devices of an entire train of cars from either end of any one car in the train."

This patent is the property of the Siemens & Halske Electric company.

The means employed in this invention, however, differ materially from the means employed in Mr. Sprague's system, but it is evidently not new to have a number of cars in a train provided with motors and have all of these motors operated from one point, preferably the front car.

It seems to me that the greatest advantage of such a system would be the great saving in the cost of the steel structure of elevated railways and saving of track repairs. It is evident that when a steam locomotive hauls a train, the structure must be much heavier than if an electric motor were used, as the locomotive itself has to be very ponderous in order to haul a train of cars, and the destructive effect on the track and the maintenance of way would be greatly increased; the rule is, that this effect increases with the square of the weight. If every car of the train is provided with motors, the total weight of the train is reduced, and the weight of the train is evenly distributed over its whole length.

Actual figures made by competent engineers show that in one of the elevated roads in Chicago, which was originally built for operation with steam locomotives, 45 per cent. of the cost of the elevated structure might have been saved if electrically operated cars had been adopted.

Considering the cost of an elevated structure, 45 per cent. means an enormous saving in the total first cost of the road, hence in the interest on the capital invested.

From this it will easily be seen that an elevated road laid out and built for steam operation might not be a paying investment, while the same elevated road, erected on the principles here mentioned, might show a great earning power.

Reprints from the *Philosophical Magazine* for March have been received containing the "Discussion of the Currents in the Branches of a Wheatstone Bridge, Where Each Branch Contains Resistance and Inductance, and There is an Harmonic Impressed Electromotive Force," by Albert Cushing Crehore, Ph. D., assistant professor of physics, Dartmouth College, and George Owen Squier, Ph. D., first lieutenant, United States army.

Wire Burying in Boston.

When Boston determined that the electric wires should go underground, with the single exception of trolley wires, it went at the work in a very systematic way. The city was divided into sections, and it was decreed that, beginning with 1894, the wires in each section should be buried in the year set for it. To enforce this law and supervise the execution of the work the Wire Department was created. This, for the year ended January 31, 1897, as shown by "City Document No. 33," had an appropriation of $50,000 and was in charge of a commissioner of wires, Thomas W. Flood, with a salary of $5,000. Mr. Flood's report, recently issued, which constitutes the "city document" enumerated, is elaborate and valuable. The commissioner says:

The prescribed district for 1896 has been laid out in blocks, and said blocks numbered, the wires and fixtures inspected, fixtures numbered and stamped "Wire Department," and from this inspection maps are made by the map and draughting department, showing the location of each fixture on the blocks, as well as the number of wires, the direction in which they run, and the owners thereof, and from the same source is a record in tabulated form kept of all wires and fixtures inspected, the number, location, condition and owners of same, as well as the kind of roof to which the fixtures are attached; this map also shows location of poles and wires as well as the location of all electric lights for street illumination.

As accurately as can be estimated, the total amount of overhead wires in this section of the city was 13,810,170 feet. Of this amount, no doubt, nearly one-half (6,905,085 feet) was "dead" or abandoned wire.

The fixtures inspected and numbered in this district amount to 1,570. These fixtures carry arms to the number of 2,377.

The dead-wire division has removed during the year 1,995,350 feet of wire. Of this amount 1,142,850 feet was taken from the 1896 district; the remainder is being removed by the owners and this department; 325 fixtures have also been removed. The fixtures removed bore no name and were destitute of wires, and the owners were unknown.

Of the wire taken down about 50,000 feet has been retained by the department, it being good and serviceable; of the 13,810,170 feet of wire in the district, it is estimated that 1,385,000 feet is in use for lighting and power service.

Referring to the underground work accomplished, Mr. Flood gives this description:

In the electrical subways constructed in this city five different systems are employed—sheet-iron pipe, lined with cement; plain wrought-iron pipe coated with asphalt or tar; vitrified clay and creosoted wood; but little of the last named has been laid since the organization of this department; beside these is the Edison solid-tube system, nearly all of which was constructed before the passage of the law creating the Wire Department. All but the last-named are employed in what is known as the "drawing-in system."

The great bulk of the conduit or pipe consists of the sheet-iron cement lined pattern, made in lengths of eight feet, and are connected together with a ball-and-socket joint.

In laying this conduit the bottom of the trench is first level to the grade; planks are then set against the side of the trench to sustain it. A layer of concrete is then laid and rammed in the bottom of the trench; on this is laid a row of pipe, next a layer of concrete, then another row of pipe, and so on until the desired number of layers is attained.

In order to add to the strength of the mass, and to protect same from mechanical injury, the concrete is applied more thickly on the bottom, top and sides of the subway than between the pipes; a two-inch plank is placed over the conduits to protect them in a measure from picks and crowbars in the hands of laborers employed in the streets. Substantially this same method is pursued in laying vitrified clay pipes.

Plain iron pipe is not, as a rule, laid in concrete; it is used to some extent for main ducts, but nothing else is used for service connections; each length is 20 feet long, and they are connected together by means of screw couplings having vanishing threads. The main reasons which have led to the extensive introduction of iron piping are its strength, adaptability to varying conditions of the streets and the rapidity with which it can be laid.

Vitrified clay ducts were used here this year for the first time; they are 18 inches long, 4¼ inches square, the corners being rounded. The joints are made by butting the ends together, and they are laid in cement after the manner of laying brick and then surrounded with concrete.

Access is to be had to the conduits of the subways by means of manholes, placed at an average distance of 250 feet along the line of ducts, each line terminating therein. They are built of brick, laid in cement with hydraulic concrete bottom. The outside walls are coated with cement to prevent water and gas from penetrating.

Access from the manholes to the street is had through cast-iron frames, which are set on the brickwork and provided with double covers. The ducts enter at a point easily accessible to the workmen while standing on the bottom of the manhole. The manholes average in size about five by five feet, and vary from four to 10 feet in depth.

Mr. Flood gives these statistics:

The amount of energy expended in producing light, propelling street cars, elevators and machinery is shown by the following figures:

Number of electric lights in use:

Incandescent	324,271
Arc	8,272
Total	332,543

Maximum mechanical horse power available for electric light and power, 49,473.

Maximum electrical horse power, 48,689.

The mechanical horse power is that of the boilers and engines, and the electrical horse power is that of the dynamos.

Many plants owned by private parties are not included in the above statement.

There has been a very marked increase in the use of electricity for various purposes during the last year, and the outlook is good for a still more extended use of it in the year to come.

The total work to February 1, 1897, comprised:

168,489 feet of subway.
748,246 feet of duct.
1,074,243 feet of cable drawn in.
1,108 service connections.
617 manholes built.

English Electrical Engineers Flocking to Arms.

Over in England the electrical men are taking on military airs; a corps of Electrical Engineer Volunteers has been formed, and Prof. John Hopkinson has become a major at a single bound. This sudden martial activity is quite bewildering, and the fuss and strut of it have to the peaceful American observer something of the touch of burlesque. The *Electrical Engineer* of London, dated April 30th, under the caption, "Defense, Not Defiance," outlines and approves the movement in the following terms:

The news that the queen has approved the formation of a new volunteer corps, to be called "The Electrical Engineers, Royal Engineers (Volunteers)" will be pleasing to all of our readers. The idea of forming such a body of electrical engineers originated from Dr. John Hopkinson during the early months of 1896, when the Venezuelan dispute was before the country. His words in introducing the subject to the members of the Institution of Electrical Engineers are worth reproducing at this distant time. They were addressed to brother electrical engineers, and were as follows: "You possess aptitudes which might be of great use, particularly for purposes of defense, in the unhappy eventuality of war. If you think of the use of electricity for military purposes, for telegraphs, searchlights, the training of guns, submarine mines, and so on, I think you will agree that if we were properly organized our technical knowledge must be very useful indeed." It is also announced that Dr. Hopkinson is to be appointed major of the corps. No one could be found more suitable for the post. It is also expected Lord Kelvin will be honorary colonel. The secretary for war has made arrangements to establish a training station at Tilbury. This will be a convenient point to many, as a number of large electrical firms have their works in that district. From an interview with Major Hopkinson we gathered that full details of the duties of the new volunteers are not yet to hand from the War Office, but that they are expected to be issued shortly. Those engineers—numbering about five hundred—who sent their names in as wishing to join, will then be communicated with as to whether they will be required to sacrifice this year's holiday for their country's good. We wish the new corps every success, and trust that in case of need they will, in contradiction to their usual vocation, demonstrate how destructive electricity can be.

Monopoly of the Eastern Cable Company.

The Eastern Cable company is doing so well in consequence of the war in the East and the troubles in South Africa that it is subscribing to the charitable funds of the Queen's Jubilee, and is making presents to the employes of the company, writes the London correspondent of the New York *Sun*. It is also engaged in an attempt to obtain another comfortable monopoly in the name of patriotism, which has always been its safe and successful method. If the Eastern Cable company wants to get a cable concession, it starts by circulating paragraphs in the newspapers to the effect that the interests of the empire require such a cable. In not a single instance has the artful dodge failed. The little scheme is being worked now by the Eastern company to secure a duplicate connection in South Africa. Its creatures of the press are demanding "an all-British route from Zanzibar to Durban, in view of the possibilities of war between England and the Transvaal." It may be predicted that the company will get the concession and a nice subsidy from the imperial and colonial governments. There is scarcely a cable anywhere that the Eastern company has not got a heavy hand in it. There is reason to believe that it is the suzerain of the whole cable system between England and the United States, and the apparently independent companies dare not make a move without the previous consent of the Eastern ring. Efforts were recently made to form a syndicate to build a cable system to compete with the Eastern, but it has just been snuffed out with the greatest ease. British merchants, traders and financiers despair of ever seeing genuine competition unless the Americans take the matter in hand. The latest suggestion is that at every British naval station there should be a government cable ship ready to start at a moment's notice to repair a broken cable, for the good of the empire, of course.

Interesting Power Transmission In Utah.

A power transmission plant comprising a fall of water of 460 feet through a pipe seven miles long, a transformation to electrical energy and then a 37-mile transmission over copper wires is certainly extraordinary. Such is the plant of the Pioneer Electric Power company of Ogden, Utah, which has excited much attention. The following brief description is taken from the *Mining Industry and Review* of Denver:

When finished, the Ogden system will generate 20,000 horse power. The work involved the construction of a pipe line seven miles long, which has a fall of 460 feet. The water is at present turned into the pipe by a temporary dam, which will be replaced later by a masonry dam, built up from bed rock to prevent seepage, 400 feet long and locked into solid rock of the cañon on either side. This will make a reservoir covering 1,600 acres and storing water enough to produce the 20,000 horse power all through the year.

The first six miles of the pipe line is of wood, made after special designs by the engineers of the company. The pipe is round, six feet in diameter, and made of strips of Oregon fir. Special mills were erected by Rhodes Bros., the contractors, at the mouth of the cañon, for sawing and shaping the staves. The pipe is one continuous barrel of interlocked staves, bound by hoops of steel only a few inches apart. One million four hundred and seventy-two thousand pounds of steel were used in the work. The wood is all saturated in naphtha and creosote and is practically indestructible.

The engineering difficulties in the laying of the pipe were great. Its course is along a rugged cañon wall, over gorges and through masses of rock. Over 1,600 feet of tunneling had to be done, and six steel bridges span ravines and chasms.

A mile from the power house, where the wood pipe ends, is located the biggest valve in the world. It is capable of withstanding at the valve gate a pressure of 102 tons. It is operated by hydraulic pressure, so that the force of the water can be made to open or close it. Each of the three largest pieces took 10 teams to haul it up the mountain side to its position.

From the valve to the power house, where the fall is rapid and the pressure enormous, the pipe is of fine steel. This pipe was all made on the ground by Rhodes Bros. The sheets of steel were received in sections of from 1,600 to 5,400 pounds weight, and from $\frac{3}{16}$ to $\frac{11}{16}$ inch thickness, about 18 by 8 feet dimensions. The sections were swung by electric or steam cranes from one machine to another until rolled and riveted and finished in complete pipe sections. Each section was boiled in asphaltum and made rust-proof as well as water-tight. They were then carefully tested and run up into position by a specially made steam power conveyor and hoist. In the trench, the sections were riveted together by a Pegram riveter, and by a machine especially designed by Fred W. Hart. The last rivet was driven about the middle of April.

The power house is located just within the city limits, on the east side of Ogden. It is of brick, with concrete and cement foundations and has room for 10 Pelton wheels and electric generators, each capable of generating 1,000 horse power. The water pipe divides a short distance from the power house, and a branch comes to each side.

Coupled to each water wheel is a generator and two heavy flywheels, the four weighing 16 tons. The sets are all counterparts. At present only five sets are in place, but the others will be put in as fast as needed. The pipe line can carry water for another set of 10 generators, and when the time comes a duplicate power house will be put up.

The switchboard at the east end of the building has complete facilities for controlling and measuring the current. Automatic apparatus keeps a permanent record, second by second, of the voltage, amperage, water pressure, etc., at each generator, so that if there is anything wrong the leakage can be located instantly. A meter and clock records every 10 minutes the amount of water passing through each branch of the pipe.

From the power house a pole line has been built to Salt Lake City, sufficiently strong to carry wires to transmit 100,000 horse power the entire 37 miles. Wires have already been strung to deliver 2,000 horse power and more will be added as the demand warrants.

An electric railway between the two cities, a company for which has already been incorporated, will use the current from the power house.

The company anticipates no trouble in disposing of its power. Contracts have already been let for power to operate flouring mills, lighting plants and transit companies. The rates that will be made will be such that no company using coal can compete. Pole lines will be constructed to various towns and mining camps, some of the franchises having already been applied for.

Other large power plants are already under discussion for Colorado points. The completion of this enterprise releases a valuable plant of machinery, specially designed for this line of work, and the builders of the next system will also have the benefit of valuable experience, some of which was gained at considerable expense.

The irrigation of 18,000 acres of arable lands with the

water from the tail race will be an important by-product of the enterprise. The immense reservoir in the canon will give a plentiful supply the year around, without interfering with any prior irrigation rights. The land is owned by the company and lacks only water to be one of the most fertile tracts in the West.

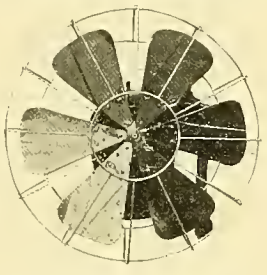
The construction of the power system was for several years a vague dream of Utah capitalists and engineers. The first attempts were on a much smaller scale than the present, but failed of financial backing. C. K. Bannister finally perfected the plans on paper, showing particularly the unsurpassed site for a reservoir and the feasibility of the scheme as a whole. A company of Utah men was formed and capital was, after many unsuccessful attempts, interested. Joseph Bannigan, the Providence, R. I., millionaire, had expert engineers, financiers and lawyers look up the matter, and about two years ago took almost the entire bond issue for $1,250,000. Since then the enterprise has been pushed to completion under the direction of Engineer Bannister, who was made secretary of the company. Senator Frank J. Cannon is its general manager, while prominent officials of the Mormon church are other officers. The project was encouraged by the church in conformity with its plan of developing home manufacturing in every possible way. The president of the company is the Mormon leader, George J Cannon.

Denver people have figured prominently in the construction of the stupendous plant. Fred W. Hart, a brilliant young electrician, has achieved a reputation almost nation-wide for his part in the work. He lived in Denver from the time he was a year old till his service began to be in demand, because of his skill in electrical science. It is conceded that his knowledge of the minute details of this plant is greater than that of any other man, he having been on the work nearly the whole time. He is the son of a former treasurer of Arapahoe county.

Rhodes Bros. of Denver were the contractors for the excavation, the pipe making and laying. William Geddes received the contract for the big dam and the seepage dam. George C. Thompson and E. E. Ingentin are other Denver men who have been closely associated with the great project.

Water-driven Fan Motor.

A supply of electric current is not always available at the times and places at which fan motors are desired.



WATER-DRIVEN FAN MOTOR.

Electrical supply houses as well as dealers in other lines meet this inquiry in business; and it is to supply this need that the Schneider Manufacturing company of 1134 Hamilton street, Cleveland, O., has brought out the tasteful water-motor fan outfit shown in the picture. This motor is designed on scientific and mechanical principles by its inventor, G. P. Schneider, who has spent several years in bringing it to its present state of perfection.

The illustration shows a new six-blade clover-leaf fan which is very attractive and gracefully put together and perfectly balanced; so much so that a slight breeze will turn the blades. Particular attention is called to the fan-blade guard, which is symmetrical in every way and makes the motor an ornament.

This motor is as easily installed as an electric fan, taking up very little space; the connection is made with any convenient hydrant or water pipe, and is guaranteed not to leak. The motor is very economical in its consumption of water, and can be operated on pressures ranging from 30 to 100 pounds. The breeze produced by this fan is powerful, steady and noiseless, and the speed can be readily regulated.

R. C. Foster, formerly of the Brush Electric company of Cleveland, is president of the Schneider company. Mr. Foster is an experienced business man in matters electrical, having been actively engaged in the financial department of the Brush company for a number of years.

Regulations of the Budapest Underground Electric Road.

Among the provisions governing the Budapest Underground Electric road, which is operated through the central portion of the city, is one fixing the life of the franchise at 90 years. According to the terms of the concession, Budapest is to receive no taxes from the road for the first 20 years, but after that time it is to receive one per cent. of the gross receipts between the twentieth and the thirtieth year, two per cent. between the thirtieth and the fortieth year, three per cent. between the fortieth and the fiftieth year, four per cent. between the fiftieth and the sixtieth year and five per cent. thereafter. Furthermore, it is enacted that during the first 25 years of the concession no other line shall be built from the interior of the city to the suburbs.

Interesting Railroad Transformation in Connecticut.

Among the recent applications of electrical power to railroads using steam locomotives, perhaps the most interesting is that which reached the stage of an official test last week on lines of the New York, New Haven & Hartford Railroad company between Berlin and New Britain and from New Britain to Hartford. The first electric car was officially run over the electrically equipped track on May 11th by Col. N. H. Heft, the chief of the electrical department of the company, in the presence of President C. P. Clark, Vice-presidents Hall and Mellen, the directors and other prominent officials of the New Haven and New England systems. It is said that this section is the longest section of any railroad in the world, hitherto exclusively operated by steam locomotives, to be equipped for electric traction. The total distance is 12.3 miles, divided in two parts, the first running from the power house at Berlin, the second extending from New Britain to Hartford.

For the electrical operation of the road a contact rail is used, and this rail is laid between the track rails, on the ties and at the ground level. This is the especially interesting feature of this electrical equipment. Current is fed into this rail at 650 volts. Further details are furnished by the General Electric company, which supplied the electrical apparatus:

In cross-section the contact rail resembles a flattened A and weighs 93 pounds to the yard. It is laid upon blocks of wood impregnated with insulating material. The blocks allow 1⅝ inches from the eave of the third rail to the tie, and in some places only 1½ inches. This is due to the fact that that no greater height could be allowed in view of the height of the service rails. The top of the third rail is about one inch higher than the level of the tops of the running rails. The conductors are bonded, not by the ordinary leaf or stranded copper bond, but by plates of sheet copper one-eighth inch thick, 12 inches long and 4½ inches wide. These are fastened to the underside of the third-rail joints by means of a drop-forged iron angle-plate bolted by 16 bolts, eight for each copper plate on each side of the third-rail joints, the nuts being outside the rail. Each bond has a capacity of about 900,000 circular mils. The total bond at each joint has about twice the carrying capacity of the rail itself, while its measured resistance is less than an equal length of the 93 pound third rail. One of the most striking facts in this installation is the absence of feeders, entire dependence being placed on the carrying capacity of the well-bonded rail.

On the Berlin branch are four grade crossings. On the New Britain and Hartford line 18. At all of these crossings the third rail is omitted, the circuit being continued underground by stranded bare copper cables of 500,000 circular mils, and in some cases 850,000 circular mils. These cables are first drawn into creosoted wooden conduits filled with an insulating material made of residuum and asphalt. They are then laid in creosoted wooden troughs in turn filled with the same compound and then boxed over and buried. The broken ends of the third rail are fitted with wooden inclines or approach blocks to allow the shoe to rise upon the rail without danger of catching and breaking.

Contact is made with the third rail by means of sliding shoes. These are of cast-iron, 12 inches long and four inches wide, weighing about 20 pounds. They are suspended by two links from a casting fastened to a beam set immediately beneath the king pin of each truck, connection between motor and shoes being made by flexible cables. The distance between the two shoes is about 33 feet. Many of the grade crossings are wider than this, and to avoid carrying the train over the crossing by momentum another shoe is fitted to each truck of the second car of the train, a connection running from this shoe to the motors. Thus, by the time the last shoe has left the third rail at one end the first shoe is in contact with the next section of the rail.

The question of the safety of the public was not the least important which demanded the attention of the officials of the New Haven road. At Berlin and Hartford stations the third-rail section is fenced in on both sides. At New Britain, where the lines of the New Haven and New England systems converge, in addition to the fence, a method which almost amounts to interlocking is adopted. In the "Y" formed at the convergence of the roads is the switchman's tower. From the section of the rail entering the station cables run underground to a switchboard in the tower, for which the third rail may be connected to or disconnected from the circuit. As the train comes to a stop in the station the third rail is cut out, and is not thrown into circuit again until the outgoing train is ready to start. The chance of accident is thus reduced to a minimum.

The annual meeting of the General Electric company was held at Schenectady on May 11th, when the old board of directors was unanimously re-elected. At the meeting 210,000 shares were represented.

The Electric Railway in Europe.

United States Consul Germain at Zurich, Switzerland, has furnished the State Department a report on European electric street railways. He states that the number of lines in operation at the beginning of last year increased from 111 to 150, their total length from 542 to 878 miles, the capacity of the power stations from 25,095 to 47,596 kilo watts, and the number of motor cars from 1,747 to 3,100.

The relatively small increase in the number of lines as compared with the increased capacity of the power stations and motor cars shows that the development of street railways has taken place principally in the larger cities and systems. Germany stands again at the head with 386 miles and 1,631 cars, as against 492 miles and 11,469 cars in all other European countries. If, however, the superficial area and the population of the different countries are taken into consideration, Switzerland, which in regard to the absolute length of lines and and number of cars is classed as fifth, with 17 lines, a total length of 47.5 miles and 129 cars, stands first in line in the European street railway traffic.

The overhead wire system is still generally used. Out of 150 lines, 122 use the trolley system exclusively. The subterranean conduit system has been introduced lately in several large cities. The number of lines operating a center rail and those with accumulator systems show but little increase, but of late projects are maturing on two lines, namely, in Hanover and Dresden, whereby a mixed system is to be introduced; that is, the power for the lines in the hearts of these cities is to be supplied from accumulators, while for the suburban traffic the trolley system is to be utilized.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 15.—The work of the Rapid Transit Commission drags along slowly, and more or less attention is paid to the task of getting the consents of property owners along the proposed route. Addressing a meeting called for this purpose a few days ago, President Orr said that the motive power used would be electricity, that there would be plenty of light, and that every known device would be resorted to in order to deaden the noise. Some of the property-owners present expressed the belief that the foundations of buildings along the route would suffer, and that the noise of the trains would be great, but Mr. Orr assured them they were mistaken.

There are damaging rumors afloat in relation to the affairs of the E. S. Greeley & Co., which passed into receivers' hands some time ago. General Greeley is in town, and he states that a thorough investigation will be made. If there was any wrong-doing, he says, it will be uncovered, and no guilty person will be spared. It is hinted that the failure was precipitated by loose business methods, and that a trusted employe misappropriated a large sum of money.

The delay in the construction of the trolley-conduit lines of the Metropolitan Street Railway company, owing to what seems to be the spiteful opposition of the Third Avenue company in the courts, is exasperating the citizens of the region affected, who are petitioning for a cessation of this warfare. Commissioner Collis has issued a permit for the excavation and electrical construction in Sixth and Eighth avenues. The subway commissioners protested, however, that that part of the permit relating to the electrical construction was void, as the commissioner of public works had no authority to issue it unless a permit had first been granted by the Subway Board. Several communications passed between the commissioners and Gen. Collis on this subject, the latter protesting that he had acted within the scope of his authority. The Board of Electrical Control, including the mayor, did not think so, and by unanimous vote directed Corporation Counsel Scott to take such steps as may be necessary to revoke Gen. Collis' order where it conflicts with the authority of the Subway Commission. The *Herald* has taken the matter up, and in a vigorous editorial on "Intolerable Warfare Against Public Rights and Interests," says: "These improvements are awaited with impatience by the residents and property owners of the entire West Side. They are urgently needed to relieve the congestion on Broadway. They are a pressing public necessity, and will be hailed as a public boon. A majority of the property-owners along the routes have given their consent to them, the State Railroad Commission has authorized them, the commissioner of public

works has granted the necessary permit to proceed with them, and the Metropolitan company is ready to begin the work at once and push it with vigor by the employment of 10,000 men and the expenditure of $7,000,000. Yet the Third Avenue company, with a devilish dog-in-the-manger spirit and brazen indifference to the wishes or welfare of the people, has contrived to tie up the whole enterprise." The article concludes with the statement that "Unless the Third Avenue company can show good cause for its course it is high time for the courts to call a halt on its intolerable obstruction of public improvements."

Park Commissioner Dettmer of Brooklyn has awarded the contract for the construction of the electric fountain in the Prospect Park plaza. The cost is $24,500. The fountain was designed by F. W. Darlington of Philadelphia. It will be 370 feet in circumference, and the contract calls for the throwing of 100,000 gallons of water an hour. The power is to be furnished free of cost to the city by the electric railroad companies.

The curious suit of the church of St. Monica against the Phillips Electric Motor company for $1,000 damages for the breaking down of the motor which pumped the church organ on Easter Sunday was to have been tried before Judge McCarthy on Monday. The defendants were not present when the case was called, however, and an inquiry was ordered. M. S.

Northwestern Notations.

MINNEAPOLIS, May 15.—The new Duluth-Superior bridge draw was swung by electricity successfully this week.

The electric light plant at Mt. Pleasant, Ia., will be appraised with a view to the city's purchasing it.

An electric light plant is projected at Reinbeck, Ia.

A private electric light plant in Farmington, Minn., is again being talked of.

The street railway company of Duluth, Minn., will extend its line to Ironton if the steel plant which has been started there proves a success.

The court has granted an injunction to the city of Stillwater, Minn., restraining the owners of the street car line from tearing up the tracks. It also grants the owners the right to appeal to the council for permission to tear up the tracks, and in case it is denied, they are granted the right to apply for another injunction to compel the council to give that permission. Steps are being taken to purchase the line and operate it.

Hancock, Mich., will vote May 24th on putting in an electric light plant.

The electric light plant at Langden, N. D., is expected to be in operation by August 1st.

Roger Leavitt and others have purchased the electric light plant at Cedar Falls, Ia., and will expend $12,000 in rebuilding the system.

The Waterloo, Ia., council censured the Rapid Transit company severely for not giving the service promised and failing to live up to the franchise, and the company was warned by resolution to conform to the agreement under penalty of annulment of its franchise.

An option has been given on the plant of the Green Bay Gas & Electric Light company of Green Bay, Wis., to the Fox River Electric Railway company until July 15th. It involves a deal of $300,000 and the object is the consolidation of the plants.

Melonek & Engel have been granted an electric light franchise at New Prague, Minn., and will put in a system at once.

There is no agreement between the city of St. Cloud, Minn., and the electric light company as to the price to be paid for electric street lighting, and the council proposes to make it $75 per year per light for 2,000 candle power.

The finishing work on the electric power dam in Minneapolis will be begun next week and will take six to eight weeks to complete.

The council of Manson, Ia., is conferring with the electric light company on the subject of resuming the street lighting service.

A vigorous effort is being made on the part of Minneapolis merchants and people of St. Anthony Park, a suburb between Minneapolis and St. Paul, to secure street-car connection.

L. V. Gray will engage in the electric supply business at Rock Rapids, Ia.

E. S. Tobey has bought out the electric supply business of Fred A. Wood in Cedar Rapids, Ia.

Rails have arrived in Eau Claire, Wis., for rebuilding the Chippewa Valley Electric Railway company's system. C.

PERSONAL.

Samuel Insull, president of the Chicago Edison company, returned last week from an eastern trip.

George T. Hewes, manager of the Consolidated Gas & Electric company of Faribault, Minn., was in Chicago last week.

G. L. Lindsley of the firm of Lindsley Bros., dealers in cedar products at Menominee, Mich., was a recent Chicago visitor.

A. McNab Little, for the last year general manager of the Metropolitan Electric company of Chicago, has resigned and is about to start on an extensive trip throughout Canada and the eastern states, in which business will be combined with pleasure.

F. F. Sapp, an experienced telephone salesman, has taken charge of the western business of the Connecticut Telephone & Electric company of Meriden, Conn., and is establishing headquarters at 193 La Salle street, Chicago, from which point he proposes to cover this territory.

The friends of General Manager R. Berrenberg of the Globe Electric Light company of Malden, Mass., are extending their congratulations upon his marriage to Miss Mary Berghaus, which took place on April 28th, in Boston. The local papers describe the wedding as the event of the year in German-American society in Boston. There was a very large attendance, and at the reception many guests partook of the hospitalities extended. Mr. and Mrs. Berrenberg will reside in their new home in Malden, Mass.

ELECTRIC LIGHTING.

After the disaster of Velestino in the Turco-Grecian war, it is related that the searchlights of the warships on the bay flashing up the mountain sides were a great assistance to the retreating Greeks, showing the road through the intense darkness.

ELECTRIC RAILWAYS.

The Buffalo & Depew Railway company has been incorporated with a capital stock of $100,000. The company proposes to operate a road 7¼ miles in length from Genesee street, near the easterly line of Buffalo in the town of Cheektowaga, to Ellicott road in the town of Lancaster. The directors are William B. Cutter, Augustin Smith, George A. Ricker, John H. Baker, Herbert P. Bissell, J. Henry Metcalf, George C. Riley, James Murphy and Frederick M. Turner, all of Buffalo.

It is said that there is likely to be considerable development of electric railways in Russia. There is one road already established at Kief and one at Nijoi-Novgorod. These were built by Germans, but are worked by Russian companies. A Finnish company acquired a charter for building an electric road in Sebastopol and also for electric lighting, but this has been turned over to a Belgian company established by Chandoi & Cockerill. This company is negotiating for rights to build electric roads in at least four other places.

It is said that the consolidation of the Baltimore Traction company and the City & Suburban Railway company of Baltimore which control all except two of the street railway systems of Baltimore, has been practically effected, and that meetings of the stockholders of the companies will be held to-day to ratify the agreement. The plan of consolidation includes the issue of $9,000,000 of stock, which will be exchanged, dollar for dollar, for the outstanding stock of each company. There will be no issue of bonds, but the consolidated companies will resume the bonded indebtedness of the two companies, including $800,000 convertible five per cent. bonds issued by the Traction company several months ago. The two companies operate about 170 miles of track.

TELEPHONE.

Paul Minnis, representing the Best Telephone Manufacturing company of Baltimore, Md., has been in Mobile, Ala., investigating the feasibility of erecting a factory in that city. A plant to involve $100,000 and employ nearly 100 workmen is talked of.

The Lockport (N. Y.) Telephone company has been incorporated with a capital stock of $25,000. The company proposes to operate a telephone system in the city of Lockport. The directors are Lawrence J. McParlin, Peter F. McParlin, M. E. McParlin and S. Curt Lewis of Lockport, William Clark of Fort Plain, Elmer E. Summey of Buffalo, and Isaac J. Evans of Rome, N. Y.

At the annual meeting of the New England Telephone & Telegraph company the following-named gentlemen were elected directors: Charles F. Ayer, John H. Cahill, Benjamin C. Dean, William H. Elliott, William H. Forbes, John E. Hudson, Henry S. Hyde, Albert O. Morgan, David B. Parker, Moses A. Parker, Stephen Salisbury and Thomas Sherwin. These were selected as officers: Thomas Sherwin, president; Henry S. Hyde, vice-president; William R. Driver, treasurer; Samuel W. Leedom, secretary; Jasper N. Keller, general manager.

A new Iowa law requires telegraph and telephone companies, in addition to the representations they are now required to make to the auditor of state, to make annually a report showing in detail their property, capital, receipts and expenses. The statute also provides a penalty of $100 per day for every day such companies refuse or neglect to make such reports to the auditor of state. Railroad companies are also required to report the actual value of each sleeping or dining car on the lines in the state. The law as thus amended is the most severe on corporations of this sort of any enacted in Iowa.

TELEGRAPH.

A favorable report has been made by the committee of the Michigan Legislature having under consideration the bill requiring the telegraph companies to exchange business in Michigan. The companies have made a strong fight against this bill, but it will probably pass.

The Postal Telegraph-cable company completed its new southwestern system of telegraph lines between Memphis and Little Rock, on May 7th. Telegrams of congratulation were received by President Chandler of the Postal company from Governor Jones of Arkansas and from other state and city officials upon the advent of the telegraph company's system into the capital of that state.

Antotto, in Schoa, has been connected with Harar by a telegraph line built by French engineers, who had previously run a line from the coast to Harar. The first message was sent to M. Lagarde, the head of a mission to Negus Menelik, saying that he had been completely successful and engaging his passage on a French mail steamer. The Abyssinian end of the trans-African telegraph may be ready before the Rhodes system is completed.

The New York Central & Hudson River Railroad company is conducting an experiment between the train dispatchers' offices at Albany and New York, to continue 30 days, that will be watched closely, as it consists of transmitting a typewritten message to New York directly, that is, without having it translated into the Morse code. The machine employed is known as the Rogers printing telegraph machine, and is the property of the United States Postal Printing Telegraph company of New York.

At the annual meeting of the Telegraphic Historical Society of the United States in Washington, William B. Wilson of Philadelphia was elected president for the ensuing year. During the course of the meeting Secretary Maynard laid before the society a copy of the first telegram sent over the wire west of the Alleghany Mountains. The message was from Adjutant-general G. W. Bowman to President Polk. General Bowman was at that time (December 29, 1846) at Pittsburg, organizing the Second Regiment of Pennsylvania Volunteers gathered there for service in the Mexican War.

POWER TRANSMISSION.

Ten miles west of the city of Anderson, S. C., at Portman Shoals, on Seneca River, the Anderson Water, Light & Power company is erecting a plant for generating and transmitting 1,600 electric horse power to that city. The power house is built for an ultimate capacity of 5,000 horse power. Four pairs of horizontal 30 inch McCormick turbines and two 600 kilowatt S. K. C. two-phase alternators will be installed as the initial generating plant. The line potential will be 11,000 volts and the length of transmission 10 miles.

A dispatch from Montgomery, Ala., announces another important plan to transmit electric current for power and light purposes. The Tallassee Falls Manufacturing company, which owns a large textile plant at Tallassee Falls, 30 miles from Montgomery, is constructing a power house capable of developing 5,000 horse power, which will be used to operate its mills. It is estimated that only 2,000 horse power will be required for this purpose, and it is proposed to transmit a current equal to 3,000 horse power, if necessary, to Montgomery. The Mutual Power & Light company of that city will utilize the current in its electric light system and for various industries, if desired. Among those who are especially interested in the plant are W. F. Vandiver and C. G. Abercrombie.

The Cairo correspondent of the London *Times* reports that Professor Forbes, who has just returned from Wady Halfa, expresses a highly favorable opinion about utilizing the power of the cataracts of the Nile, for generating electricity, and considers the general circumstances of Egypt exceptionally well adapted for its use as motive power. He thinks that the cataract power would be available all the year round for working the railway, cotton ginning mills, sugar factories and irrigation machines, and also that it could be supplied over distances of several hundred miles at a cost much below that of coal. Professor Forbes will return to Egypt in September next to make a complete survey and present the government with a project for utilizing the electricity to be generated at the Nile cataracts.

MISCELLANEOUS.

The Manufacturers & Inventors' Electric company of New York city has been incorporated, with a capital stock of $5,000. The directors are Thomas J. Smith of Roselle, N. J., and Edward K. Curtis and William J. Cordo of Brooklyn.

Favorable report is made of the business of the Edison Electric Illuminating company of New York (inclusive of high-tension systems) for April. The gross earnings were $206,142, an increase of $26,032, and net, $100,844, an increase of $20,260. From January 1st to

April 30th, gross earnings were $867,116, an increase of $89,446, and net, $425,814, an increase of $66,445.

It is stated by the *Electrical Worker* that the Earls of Electra, a new mystic society, which will take the place of King Hotu (the Funny Fellows) will make their first appearance in St. Louis October 1st. As the name indicates, electricity will be the main feature of the pageant of the Earls of Electra, which it is said will surpass the famous Veiled Prophet parade, and should give considerable work to electrical workers during the summer months.

The bill in equity brought by the Consolidated Safety Valve company against the Ashton Valve company and others in the United States Circuit Court, for an injunction to restrain the defendants from the alleged infringement of a patent for steam safety valves, granted January 19, 1869, to George W. Richardson, was dismissed by Judge Colt to-day, says the *Boston Herald* of May 7th. The court holds that the proper construction of the Richardson patent requires that the aperture at the ground joint caused by lifting the valve should always be greater than the aperture for the exit of steam into the open air. The defendant's valve does not embody this construction, and the court holds that it does not infringe upon the plaintiff's patent.

TRADE NEWS.

The Wagner Electric Manufacturing company of St. Louis, heretofore associated with alternating current applications, announces a line of direct current motors and generators. The machines are multipolar, and the sizes tabulated in Bulletin No. 3 of Calalogue No. 101 run from one to 20 horse power. The company, in this bulletin, makes some interesting observations on direct current machinery in general and describes its new line briefly, giving assurance that it has departed in no wise "from the high standard maintained in every other line of its manufactured product."

The working tools of the late Pliny Jewell, founder of Pliny Jewell & Sons, and later succeeded by the Jewell Belting company of Hartford, Conn., are relics which attract considerable attention in that vicinity. They consist of a currier steel and turning tool, which are mounted and hung in a handsome glass case in the offices of the company. These tools were all made by Mr. Jewell, who was one of the pioneers in the manufacture of leather belts in this country, his first shop being located in a barn on High street in Hartford in 1848. To this place the trade came from many miles about in order to secure his product, because of its excellence of manufacture. This high standard has always been maintained by his successors in business.

BUSINESS.

The second edition of Derrah's "Street Railway Guide for Eastern Massachusetts" is out. It seems to fulfill well the promise of its title, and, with its excellent map, should be of great value to those using, for business or pleasure, the great network of electric railways surrounding Boston.

The Eddy Electric Manufacturing company of Windsor, Conn., is enjoying a season of business activity, and has lately made a number of important installations. Secretary A. D. Newton has recently returned from a short but successful business trip to Chicago and other points in the West, and he states that indications point toward a good trade from that section of the country this fall. This concern is working the full complement of hands in its factory at Windsor.

The Electrical Exchange of 166-174 South Clinton street, Chicago, is prospering, and is making shipments of electrical material and machinery all over the West. It handles all types of apparatus, some new and some that has been used, and it is almost sure to be able to meet the wants of any customer. In these days of close buying it is no wonder that prospective purchasers correspond with such a concern as the Electrical Exchange before placing their orders.

Soldering flux for electrical work has been put on the market in a variety of different shapes. The latest thing in this line is the Highland insulating soldering paste, which is being placed upon the market by the Electric Appliance company. Great claims are made for this paste on account of its convenience and non-corrosive qualities. The Electric Appliance company is prepared to send small sample boxes of this soldering paste to the trade on application, as it feels confident that the merits of the paste will bring business where it has once had a test.

The Berliner decision does not seem to have affected the business of the Western Telephone Construction company adversely. In fact, that company reports a more favorable business since the decision than it had previous thereto. It reports contracts for seven new telephone exchanges, involving the use of over 2,000 telephones, since the decision was published. Some of these contracts are for furnishing apparatus in place of other makes. Among the contracts are one for a 300 instrument equipment for Spartansburg, S. C.; 150 for Florence, Ala.; 300 for a new branch exchange at Fort Wayne, Ind.; 100 for Aledo, Ill., and 200 for Cameron, Mo. It is asserted by the company that its business will show a very large increase in the next three months. It is putting in a large amount of new machinery and extending its capacity one-third the present manufacturing ability. It reports having received letters from all over the country asking what effect this Berliner patent decision will have, and also reports additional orders for increase for nearly all of its present exchanges, which were held awaiting the exact position of the Supreme Court upon this patent.

The Ball Engine company, Erie, Pa., reports the following recent shipments of engines for electric purposes: Vulcan Coal company, Treveskyn, Pa., one 225 horse power direct-connected to generator; Queen City Electric Light & Power company, Clarksville, Tenn., one 125 horse power engine; Langhorne Electric Light & Power company, Langhorne, Pa. (third order), one 200 horse power engine; Maxwell House, Nashville, Tenn. (third order), 125 horse power engine, direct-connected to dynamo; Rockville Water Works, Rockville, Md., one 80 horse power engine; Wilmington Gas Light company, Wilmington, N. C. (third order), one 300 horse power cross-compound engine; Pennsylvania Tube Works, Pittsburg, Pa., one 60 horse power engine; Seaboard Air Line, Portsmouth, Va., one 70 horse power engine, direct-connected to dynamo; Apollo Iron & Steel Works, Apollo, Pa. (fourth order), one 150 horse power vertical cross-compound, direct-connected to alternating machine; Kirk's soap factory, Chicago, Ill., one 50 horse power engine, direct-connected to dynamo; Lexington Hotel, Richmond, Va., one 40 horse power engine; Congo Mining company, Congo, O., one 175 horse power engine; Wainwright Brewing company, Pittsburg, Pa., one 80 horse power engine, direct-connected to dynamo; Fox Pressed Steel company, Pittsburg, Pa., one 100 horse power engine, direct-connected to dynamo; F. O. Norton Cement company, Binnewater, N. Y., one 60 horse power engine; Lakewood Hotel & Land company, Lakewood, N. Y., one 165 horse power tandem compound engine.

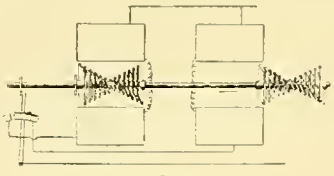
ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 11, 1897.

582,187. Telephone Controlling Device. Thompson A. Dull, Chicago, Ill. Application filed October 14, 1895.

This device comprises a coin-receptacle, a coin-chute leading to the interior of the receptacle, an electrically operated coin-detent within the chute, an electro-magnet arranged to operate the detent to hold a coin in position to be recovered while the magnet is energized, and mechanism for ejecting the coin.

582,200. Telephone Transmitter. Robert P. Green, Columbus, Ohio. Application filed January 11, 1897.



NO. 582,212.

A microphonic element composed of oxygenated sulphide of copper is the principal feature of this invention.

582,218. Electric Motor. John A. Mosher, Chicago, Ill. Application filed February 9, 1893.

An armature for electro-magnets, consisting of a number of plates arranged in succession upon a shaft obliquely to the axle thereof is described.

582,259. Electric Trolley Device. William M. Brown, Johnstown, Pa. Application filed December 16, 1896.

An upwardly pressed tube has a longitudinal opening; a member is adapted to move longitudinally along the tube and bearing on the inside thereof, and a contact-maker is mounted upon the moving member.

582,262. Electrically Actuated Switch. James Bryan, Pittsburg, Pa. Application filed August 1, 1896.

The principal features are a movable switch-point, a lever having a yielding connection to the switch-point, a cam mechanism shifting the lever, a magnet for actuating the cam mechanism, and a brake operated by the magnet for controlling the movement of the cam mechanism.

582,269. Armature for Dynamo-electric Machines. Ernest P. Clark, New York, N. Y. Application filed July 16, 1896.

An armature core for dynamo-electric machines and motors is built up of sections, each of which is composed of iron plates or punchings, having the general shape of the letter H with one of its sides removed, the plates being in tiers or piles and arranged in the section with their side pieces alternately to the right and left, and with their cross-pieces overlapping each other.

582,303. Electric Switch. William J. Newton, New York, N. Y. Application filed January 28, 1897.

A wall-switch combines the insulating body, having stationary contacts at the edge, the metallic frame secured to such body and having posts and arms, with the rocking-lever, manual lever and push-pins fitted movably to such frame, such parts being adapted for adjustment apart from the body, and for co-operation with the stationary contacts when the frame is secured to the body.

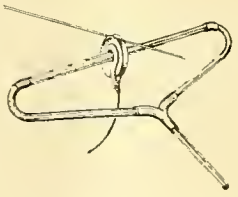
582,337. Trolley Wire Hanger. John E. Atwood, Stonington, Conn. Application filed October 12, 1895.

The claim is given: In combination, a trolley wire, clamping plates extending along the wire and having jaws for partially embracing the same, bolts extending transversely through the plates for locking them to the wire, a supporting wire, insulating plates above and below the supporting wire, a bearing-plate located above the upper insulating plate, and locking bolts having their heads seated in the clamping plates and engaging the said insulating and bearing plates for securing the supporting wire and trolley wire together.

582,344. Support for Trolley Wires. Edward J. Cook, Cleveland, Ohio. Application filed March 6, 1897.

A trolley ear having a chambered groove with projecting lips adapted to be inserted over the flattened trolley wire surface when turned to an unusual position, and to engage and hold the sides of the wire when turned to the usual or supporting position.

582,461. Electrical Indicating Device. William W. Dean, St. Louis, Mo. Application filed September 19, 1896.



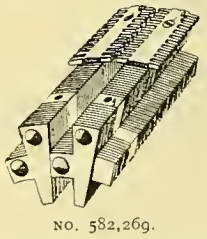
NO. 582,259.

There is the combination in an electro-magnetic device with convergent pole-pieces of a helix adapted to energize the pole-pieces during the passage of current through the helix, an armature maintained between the inner faces of the pole-pieces adapted to be actuated by the same to assume a position approximately of their maximum magnetic intensity when the pole-pieces are energized, thereby effecting a signal, and means for normally removing the armature from its position.

582,462. Electric Circuit Terminal. Edward N. Dickerson, New York, N. Y. Application filed April 5, 1897.

An electric terminal attached to a circuit wire, the same consisting of a substantially U-shaped flat portion, one of the arms of the U being provided with a rounded projection.

582,493. Electric Meter. Georg A. J. Telge, Oldenburg, Germany. Application filed November 16, 1896.



NO. 582,269.

A coil is provided for the current to be measured, a core for co-operation with the coil, and upright springs, one on each side of the pendulum, pivotally arranged levers to which the springs are secured, a slide-piece with sloping sides arranged between the levers and connected with the core.

582,494. Core for Electrical Machines. George Westinghouse, Pittsburg, Pa. Application filed January 20, 1897.

A core for electrical machines comprises a casting having a cylindrical surface, laminæ supported thereby, an annular clamping plate and a fastening ring interposed between the clamping plate, and a shoulder on the casting.

582,522. Telephone. Cleaveland F. Dunderdale, Chicago, Ill. Application filed June 17, 1895.

In a telephone receiver a temperature compensating device, consisting of a bent bridge secured to the receiver-casing at each of its sides and supporting the magnet or magnets, the extension piece of the magnet being secured to the bridge at that end thereof remote from the diaphragm, whereby the bent portions of the bridge are adapted to expand or contract in one direction and the extension piece in the other, and preserve constant the distance between the end of the extension piece and the diaphragm.

582,578. System of Electrical Inter-communication. Emery A. Clark, Sioux City, Iowa, and Joseph P. Ellacott and Walter J. O. Johnson, Chicago, Ill. Application filed September 28, 1893.

In a transmitter there is the combination with a central shaft, an indicator mounted thereon, and a circuit-changing wheel also mounted thereon, of a yielding connection between the indicator and the wheel for causing movement of the wheel in the direction of movement of the indicator after each setting of the indicator to a position corresponding to that occupied by the same, and contact mechanism operated by the wheel.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, MAY 29, 1897. No. 22

Electric Lighting Plant Set Up in Court.

A number of electrical men—engineers, salesmen and contractors—are interested in the case of the Eddy Electric Manufacturing company against the Chicago Athletic association, which is now on trial in the Superior Court of Cook county before Judge Ewing and a jury. The plaintiff in this case is endeavoring to recover the sum of $15,000, said to be due on the contract for furnishing the electric lighting plant installed in the fine building of the Athletic Club, on Michigan avenue, over four years ago. The defendant asserts that the plant was defective, proceeding on the counsel of Henry Ives Cobb, the architect, and his electrical advisers. The plaintiff, on the other hand, contends that the dynamos—two 60 kilowatt machines and one of 45 kilowatts—were all right, but that they were subjected to such improper usage that trouble was caused. The Eddy dynamos were finally removed, as the result of the dispute, and a plant supplied by the Chicago Edison company is now in operation. Nevertheless, the Eddy company pressed vigorously for a settlement, and this suit is the result. There are a large number of witnesses, and it is interesting to record the fact that one of the attorneys for the defense is a woman—Catherine Waugh McCulloch.

One of the points which the Eddy people sought to impress on the jury was the fact that poor regulation of the driving engines would have a correspondingly bad effect on the quality of the light irrespective of the qualities of the dynamos. To give an ocular demonstration of this proposition a small electric lighting plant was fitted up in the court-room, directly in front of the jurors' chairs, as shown in the picture, which is a reproduction of a photograph taken before the opening of court. The engine was represented by a Gibbs motor operated by a temporary connection with the courthouse circuits. This driving motor was directly belted to a small compound-wound Sprague dynamo, which supplied current to a bank of 20 incandescent lamps. The speed of the motor was manipulated by a suitable resistance-box, and the jury was shown how the light was affected by variations in the speed of the driving motor. This experimental apparatus was in position for several days, and attracted much attention from all having business to transact in the court.

ELECTRIC LIGHTING PLANT SET UP IN COURT.

National Electric Light Association.

The programme of the twentieth convention of the National Electric Light association at Niagara Falls, June 8th, 9th and 10th, has just been issued.

The first day's business will include the address of the president, Frederic Nichols; report of the committee on standard candle power of incandescent lamps, by Louis Bell, chairman; report of the committee on data, by H. M. Swetland, chairman; report of the committee on rules for safe wiring, by William Brophy, chairman; report of the committee on finance, by John A. Seely, chairman; paper by J. B. Caboon of Elmira, N. Y., on "Standardizing Prices for Incandescent Light and Power;" discussion of topic, "Theft of Current and How to Deal with It;" paper by W. Worth Bean of St. Joseph, Mich., on "Municipal Lighting."

On Wednesday the following features will be presented: Paper by C. L. Edgar, Boston, Mass., on "Correct Method of Charging for Product;" paper by J. G. White, New York, N. Y., on "The Niagara Power Transmission Line;" paper by Arthur Wright, Brighton, England, on "Profitable Extensions of Electricity Supply Stations;" discussion of topic, "Commercial Results with Inclosed Arcs;" paper by Prof. Chas. A. Carus-Wilson, McGill University, Montreal, Can., on "The Induction Factor, a New Basis of Dynamo Calculation and Classification;" paper by Prof. Elihu Thomson, Lynn, Mass., on "Recent Progress in Arc Lighting;" paper by T. C. Martin, New York, N. Y., on "The Daylight Work of Central Stations." An evening session at the Lyceum Theater will be held to consider the paper by L. B. Stillwell of Niagara Falls, N. Y., on "Niagara Power" (illustrated with stereopticon).

The closing day of the meeting, Thursday, has many attractions, including a paper by B. F. Lamme, Pittsburg, Pa., on "Polyphase Motors;" discussion of the topic, "Best Efficiency for Incandescent Lamps;" paper by Lieut. F. Jarvis Patten, New York, N. Y., on "Frequency Transformation;" discussion of the topics, "Are the Large Arc Lighters Commercially Desirable?" and "Lamp Carriers Other Than Ordinary Posts;" paper by C. F. Scott, Pittsburg, Pa., on "Rotaries for Transforming Alternating into Direct Current."

The reports of the secretary and treasurer and the executive committee, followed by the election of officers, will close the proceedings of the convention.

The social features of the meeting, as announced, will prove attractive, as they include several excursions about the Falls and visits to the power plants and industries which have been located at Niagara, and have been developed with the electric interests there.

Alley "L" Contracts.

In addition to the order given to Frank J. Sprague for the car equipments, the South Side Elevated Railroad company of Chicago has just closed several other contracts for the new electrical equipment of the Alley "L" road. The copper for feeders will be supplied by the Western Electric company. About 400,000 pounds will be required in the form of 500,000, 1,000,000 and 1,500,000 circular mil cable of bare, stranded copper wire. The Westinghouse Electric & Manufacturing company secured the order for the generators. There will be four 10 pole 800 kilowatt machines having an electromotive-force output of 600 volts. The engines will be supplied by the E. P. Allis company, and will be cross-compound, turning at 80 revolutions per minute and rated at about 1,500 horse power each with steam at 150 pounds pressure. The engines and dynamos will be directly connected. Eight Babcock & Wilcox water-tube boilers of 500 horse power each will supply the steam. These boilers will have forged steel headers and will be equipped with chain grates for mechanical stoking.

The new Huron street lift bridge over the Milwaukee River at Milwaukee, Wis., is operated by a 24 horse power electric motor running at a normal speed of 450 revolutions per minute and geared to a train which operates the working struts.

Direct Current Transformer.[1]

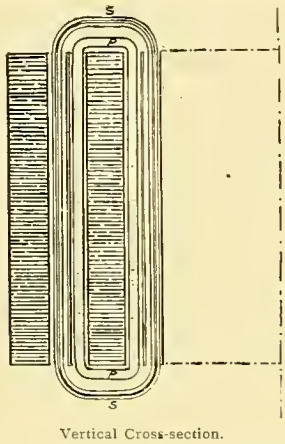
By C. Thordarson.

The transformation of energy is now, more than ever before, the main problem on which electrical and scientific men are working all over the world.

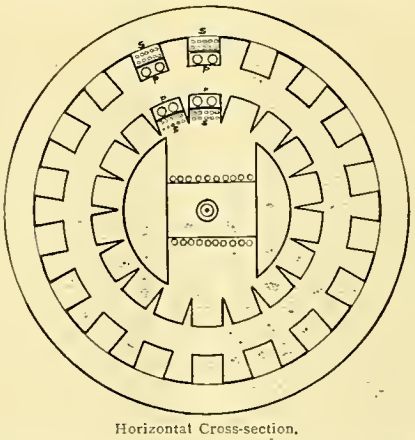
Such subjects as a practical and economical method of transforming heat into electricity and electricity into light, with a higher efficiency than is at present attainable, are problems on which at present an immense amount of time and money are being spent. We may consider electricity to have two great advantages: the quietness and compactness and comparative safety of transmitting energy in that form, and the ease of its transformation into different forms of energy, and therefore its flexibility for varied work.

Electrical engineering had not advanced very far when it was found that frequently the electromotive force and current best suited for transmission were not always practical or economical for utilization or the appliances were not suited for the electromotive force and current at hand; therefore the transmission of the voltage or current became a difficult problem, and with an increased utilization of electricity this subject is assuming greater importance.

Viewing this subect from a practical standpoint, there are only two methods at present known which are worth considering. One is using the storage battery. This necessitates a continuous current source, or an alternating current rectified by means of a synchronizing commutator. The other is the magnetic induction method which requires an apparatus in which either the conductor or the magnetic field is moving, as in an ordinary dynamo, or a changing magnetic field set up by an alternating or pulsating current supplied to it. A transformer of this kind, having no moving parts, and requiring little attendance, has frequently been found preferable to use, and alternate current machinery giving a frequency best suited for its use has been specially constructed. The only recommendation that can be given to the alternating current is the simplicity and cheapness of transforming it. In almost every other respect it is objectionable. The



Vertical Cross-section.



Horizontal Cross-section.

DIRECT CURRENT TRANSFORMER.

alternating current requires larger conductors than the direct current, and is more apt to produce all kinds of induction troubles in its own conductors as well as in neighboring lines, if not properly laid. The use of the alternating current transformer is at present limited to electric lighting, and to power transmission in connection with polyphase current working.

The direct continuous current is therefore the ideal method for transmitting electrical energy, and it has advantages over the alternating current in almost all cases, and embraces a broader field, as for instance the operation of the telephone and telegraph systems, which cannot at present be worked in any other way.

The objections to the direct current transformer are not so much questions of efficiency (for this can be made as high as the alternating) as it is the first cost and running expenses. Now the first cost of the machine is a factor that cannot be greatly diminished. An apparatus having bearings, commutator and brushes will necessarily cost more than one having only two coils encased in a stationary magnetic field. In regard to the running expenses, which constitute the wear and attendance, a direct current transformer of over 75 kilowatts capacity can be designed so as to require very little attendance, and experience has shown that an alternate transformer of the same kind does require some attendance. Here, therefore, the difference between the two is not very great. When we come to the transformation in very small units the running expense of the direct current transformer has frequently been so high that it could not compete with an alternating current equipment.

At this point there is a considerable field for improvement by reducing the cost of attendance. The only parts that require occasional attention are the bearings and the commutator and brushes. The perfection of these parts, which is largely of a mechanical nature, will make the machine profitable to use in many cases where before it was impracticable. Let us first consider the friction on the bearings, which, if the armature is well balanced, is chiefly from its weight and sometimes from lateral pressure.

The lateral pressure on the bearing can be entirely prevented by having the armature core of the same width as the field magnet poles, and the free space between the bearings and commutator the same as the length of the air space from armature core to field cores. But these proportions are only approximately true, and will vary some with slotted and surface wound armatures. When so designed the magnetic field will hold the armature absolutely free from all lateral thrust under all variation of load.

The bearing friction caused from the armature and commutator weight can be greatly diminished by mounting the armature eccentric or above the center in its running space. In this way the pull of the magnetic field will, in smaller machines, almost entirely counterbalance the weight of the armature and commutator. These are peculiar advantages of the rotary transformer, which, when properly applied in the design, can produce a machine having far less friction and bearings than can be produced in any dynamo and motor of the same output, there being no pressure on bearings from ropes or belting, as the power is only transmitted between coils that are mounted on the same armature core.

To diminish bearing friction caused by armature weight it is profitable to use on small units the bipolar type shown in the cut, and, to avoid friction from lateral thrust, all types having the field poles by the side of the armature, as the Brush machines, are objectionable.

The wear of commutator and brushes is a subject that has been well studied in dynamos and motors, and combinations have been found that are giving good results. They give far better results when used on the rotary transformer, because in them magnetic reaction between the primary and secondary circuits in the armature is so well-balanced that no sparking from magnetic induction can take place under any variation of load, neither on the primary nor secondary commutators.

Over a year ago I designed a 200 watt direct current transformer embodying most of these principles. It has run as long as 90 hours continuously without any attendance whatever.

In working out various designs of direct transformers the idea of rotating brushes and keeping all the other parts stationary will naturally suggest itself. Considerable experimenting has been done in this direction, especially by the Westinghouse and General Electric companies, but very little of this information has found its way into print. A year and a half ago I designed and constructed a machine on this plan, taking an ordinary laminated ring slotted on the external edge, and into each slot was wound one primary and one secondary coil, and over this ring was slid another laminated ring of the same width and sectional area, thereby encasing each pair of coils in a closed magnetic field. The leads were connected to a stationary commutator. Inside of the ring was mounted on a vertical shaft a field magnet of sufficient strength to produce rotation, and on this shaft were secured the arms carrying brushes and collector rings. The results might have been predicted. Each pair of coils acted as if it were an independent static transformer. That is, the same results would be obtained by taking so many static transformers, placing them anywhere at random on the floor and connecting them to commutators. We have in both cases induction and an immense amount of sparking, and the sparking is so violent that it is difficult to run the apparatus even through an experiment. The advantages of slotted armatures are well known, and spreading of the core teeth greatly diminishes the magnetic reluctance of the air space. If the coils are deeply sunk in the core and the slots closed over them, the self-induction caused by the closed magnetic field surrounding each coil will become troublesome.

Even if there were no sparking, this type of machine would be immensely more complicated than one having armature and commutator rotating. It necessitates an extra pair of collector rings for each commutator and stationary brushes from them, and a pair of rotating brushes for each commutator that will never work or run satisfactorily. Hence this method may be considered practically worthless.

Rotary transformers for transforming direct to polyphase or polyphase to direct are constructed essentially the same as direct current transformers.

Direct current transformers are at present chiefly used for operating telegraph and telephone circuits. For telegraph circuits the machines are required to give varying electromotive force. For that reason the primary and secondary circuits must be in two independent magnet fields, for no satisfactory variation of electromotive force on the secondary can be made in any other way. The simple direct current transformer having primary and secondary circuits in the same magnetic field will vary its speed to maintain constant electromotive force on the secondary.

1. Read before the Chicago Electrical association, May 7, 1897.

Electric Lighting by Gas Engines.[1]

By F. W. Richart.

The term gas engine in the title is intended to be used in its broadest sense, including all engines operating on the Otto cycle, whether they obtain their power from gas, gasoline or kerosene.

Engines using gasoline or kerosene have some means of vaporizing the fluid just before or after it has entered the cylinder, and are hence as truly gas engines as those which bear that name. The operation is essentially the same; the construction usually differs in but a few details.

The gas engine, having but one working stroke in each two revolutions of the crank-shaft, necessarily gives somewhat of a pulsating motion. This is one of its most objectionable characteristics, and it is for this reason that its fly-wheels are made exceptionally heavy for the power they produce. For electric lighting it is especially desirable that the motion be uniform, as a pulsating light is disagreeable. Means for alleviating or overcoming this difficulty will be mentioned later on.

The choice of the most desirable engine for an isolated lighting plant is by no means an easy task. It must be remembered that in most instances the plant is placed in inexperienced hands and expected to run for hours at a time, after starting, with no attention whatever. For these reasons the machine should be simple, have large bearing surfaces and reliable lubricating devices, and should be made so it is impossible for the valve mechanism to get out of time.

Whether the gas, gasoline or petroleum engine is to be chosen may depend upon circumstances. Gas and gasoline engines are usually so made that they are readily convertible, one into the other, by making a few changes. Gasoline will produce somewhat more power than gas when used in the same engine. Petroleum engines are distinctly different. Petroleum, being much more difficult to vaporize, requires different management from gasoline. It has a decided advantage in point of safety over either gas or gasoline, in that the fluid is not ignited at ordinary temperatures, except it be taken up by some absorbent.

There are two general methods of igniting the mixture of vapor and air after it has been compressed: hot tube and electric spark. The hot tube is the most reliable in causing explosions to occur, but has not, as ordinarily made, a long life. Some foreign builders have made tubes of porcelain that give good results. In this country they are usually made of a short piece of gaspipe which costs but a few cents and may be quickly replaced. Electric igniters are more economical of fuel, requiring no burner to keep them hot, but it seems that the majority of builders do not consider them reliable, preferring to sell a machine having a tube igniter or one having both. A third method of igniting the charge is by the heat of compression; that is, the mixture of vapor and air is compressed to such degree that, with the aid of heat from the vaporizing chamber, ignition is effected. This method is not, as far as I know, used in any engine except, perhaps, the Hornsby-Akroyd petroleum engine. The author's experience in the use of this method has been very satisfactory. There is no burning out of tubes nor misfires from weakened batteries or damaged electrodes. This method is not known to have ever been tried with any other fuel. Detail description will be given later on.

There are two methods of governing gas engines. That most commonly used is the "hit-and-miss." In this case, if the demand for power is less than the capacity of the engine, the governor cuts the supply of fuel entirely off till the speed drops enough to allow the feeding mechanism to come into action again. This is manifestly undesirable for electric lighting, for the engine may have to run for four or six revolutions between explosions, causing too great fluctuations in speed to be readily overcome by ordinary methods. The second method is by adjusting the amount of the charge to the work to be done, and having the explosions occur regularly every other revolution. With gas engines the force of each explosion is easily controlled by connecting the governor to the gas valve. With gasoline and petroleum engines it may be accomplished either by admitting or pumping a variable quantity (depending on the power required at that instant) into the vaporizing chamber, or by pumping a definite quantity and operating a by-pass or overflow valve with the governor.

In order to obtain the greatest efficiency from the engine, only that amount of air necessary to completely consume the charge should be admitted. The hot-tube igniter requires a full cylinder of gas and air to force the mixture far enough into the hot tube to cause an explosion. It is for this reason that we find the "hit-and-miss" method of governing used on the greater number of tube igniters. The exceptional cases require a timing valve to admit the mixture into the tube at the proper moment. There is a considerable range of mixtures at which gases will explode, and little attention is given by most builders to proportioning the mixture exactly, the point aimed at usually being to be certain the fuel is completely burned. If the amount of gas is too great for the quantity of air, a burning mixture instead of an explosive mixture will result, which is not

1. From the *Technograph*.

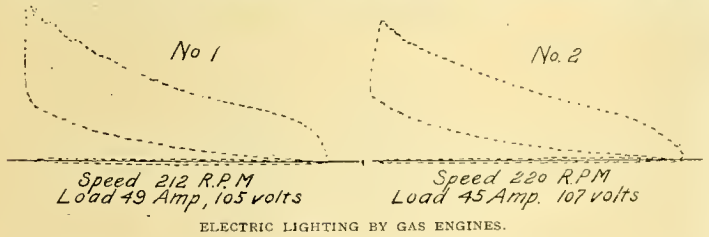
only poor economy, but gives a small amount of power. As a matter of actual economy, there would probably be but little saved by such an arrangement. It is, however, very important that combustion shall be complete, for any incomplete combination of the charge and the oxygen of the air does not result in a complete combustion of part and leave the remainder unaffected; but the whole charge is burned to a condition of smoke, and unconsumed particles, or soot, mixes with the lubricating oil of the cylinder, clogging the rings on the piston and very seriously interfering with the running of the engine.

One serious fault with some governors is that the sudden impulse given to the engine when an explosion occurs causes it to act so violently as to entirely cut off the following charge, thereby causing a momentary loss in speed. In such cases better results will be obtained by the addition of a dash-pot which is able to dampen the sudden movements of the governor.

The amount of water required to keep the cylinder cool is about 10 gallons per brake horse power per hour. Where a constant flow of water cannot be had a large tank may be used, and in fact this is the prevailing practice. A tank having a capacity of 100 gallons for each brake horse power will give good results. Smaller ones are usually used. By some authorities about 160° F. is the limit given that the water should reach. Practically as long as lubrication in the cylinder is all right there is no great harm done if the water boils. I have seen installations where the water had to boil to cause a circulation. This is wrong; there should be a complete circuit of water so that circulation may begin on the slightest generation of heat in the engine cylinder. Rain-water should be used if possible where cooling tanks are employed. When rain water is not obtainable, well or hard water may be used if care is taken to draw off part occasionally and fill up with fresh, thus keeping the amount of dissolved mineral salts to a low enough degree to prevent deposit on the walls of the water-jacket.

In the operation of gas engines in general, there are a few points worth calling special attention to. They have the reputation or sometimes suddenly stopping without apparent cause, or where an attempt is made to start them, they refuse to go, until, perhaps, after many trials they start off with no apparent change of conditions. This, no doubt, is a false charge. In the first place all bearings must be properly lubricated. Especial attention is called to the fact that cylinders often need a special grade of oil to work well—a moderately light oil with a high flash point. If the cylinder becomes blackened and the rings clogged, do not lay the blame on poor combustion unless you are sure the oil is all right. Poor combustion will always show itself by a smoky exhaust. Failure to explode may usually be attributed to one of three things: failure of charge to enter the cylinder, failure of ignition apparatus to operate (especially the electric), or failure of valve mechanism to operate, thus allowing the charge to escape before explosion can take place. With gas engines proper, there is no chance for failure of the charge to enter, except the pipe be stopped up or the valve closed. With gasoline or petroleum engines, the charge may fail to enter by reason of an empty tank, a clogged pipe, leaky pump or check valves, or clogged nozzle. With tube igniters, ignition will not fail if the tube is hot enough and the charge forced up into it. Electric igniters may fail by reason of a weak battery, broken circuit, corroded contact points or electrodes, or in some engines where it is possible for water to leak through packing into the cylinder space, water may short-circuit the electrodes and stop the engine.

The installation of a gas engine lighting plant usually carries with it the idea of cheapness of operation, and,



ELECTRIC LIGHTING BY GAS ENGINES.

therefore, cheap attendance. To fulfill this requirement the dynamos should have self-oiling bearings, radial carbon brushes run practically sparkless, and be slow speed. Dynamos now built have in general self-oiling bearings, but there is a desirable feature that but few small machines have, and that is this: There should be a cap over each bearing, hinged or removable, that is large enough to enable both rings to be plainly seen. The small glass gauges on the sides of the bearing are practically worthless to show the proper amount of oil. When the rings may be plainly seen it is an easy matter to pour in oil until the rings carry an abundant supply to the bearing. There is then no excuse for flooding the bearing and running oil all over the machine, and it takes but a glance to see that the bearing is properly supplied with oil at any time.

Radial carbon brushes are very desirable for this class of work, mainly because it is impossible to get a brush wrongly set. Non-sparking is for the same general reason desirable, because the commutator will require a minimum of attention.

One other topic demands discussion, and that is the various means of lessening or overcoming the fluctuations that necessarily occur when using gas engines, by reason of the intermittent application of the energy. The majority of engines operating on the Otto cyle receive but one impulse in two revolutions, and are, therefore, the most difficult to deal with. There are three methods of reducing the fluctuations one-half; that is, securing an impulse every revolution; first, coupling two engines on one shaft; second, putting two cylinders in tandem and exploding alternately; and, third, so constructing the engine that there is an explosion in one cylinder at each revolution. For an example of this latter engine see *American Machinist*, January 7, 1897.

To return to the subject proper, there are several ways of lessening the fluctuations of speed of the dynamo, three of which will be mentioned. First, adding revolving weight; second, using a very heavy belt; and, third, making a flexible connection between the dynamo pulley and shaft. When used for electric lighting gas engines are provided with two heavy fly-wheels, but this is usually the case when used for any other purpose. A heavy fly-wheel added to the dynamo shaft will add steadiness to the motion, or if it is not desirable to put additional weight on the dynamo shaft the same object is attained by introducing a countershaft between the engine and dynamo, and placing a fly-wheel on it. The above are the usual methods employed. Except for very small machines, or for long distances (20 feet or more) between centers, it will in all cases be found desirable to use leather link belts, for the two reasons that they are heavier than flat leather or rubber belts, and they will not flap. A flapping belt, especially on a short drive, will cause slipping on the dynamo pulley and greatly aggravate the very trouble that it is so desirable to overcome. The object of a flexible or spring connection between the dynamo pulley and the shaft is to relieve the sudden jerk at the time of the explosion. To obtain the most desirable results from the ordinary Otto cycle engine it is recommended to use heavy fly-wheels on engine, a leather link belt, a rigidly connected fly-wheel on dynamo shaft and a flexibly connected driving pulley. Some engines may advantageously be run at a higher rate of speed than that at which they are rated. An increase of 10 per cent. in speed will decrease the intensity of the pulsations in running 20 per cent.

As regards first cost, petroleum engines are 20 to 30 per cent. more expensive than gas or gasoline engines. Prices vary as widely with this class of engines as with steam engines, and the variations in quality and desirability are equally as great. The total cost of a power plant, whether gas or steam engine, will probably be about the same for like quality.

The operating expense for gas engines depends on the price of fuel. Gas engines consume 17 to 20 or more cubic feet of gas per brake horse power hour. Gasoline engines use about one pint (United States measure) per brake horse power hour. Petroleum engines burn about one pound (one pint Imperial measure) per brake horse power hour. Of course the quality of the fuel will affect the consumption to a certain degree. The great saving in cost of operation as compared with steam engines is the fact that only a small amount of attention is required and less expense of repairs.

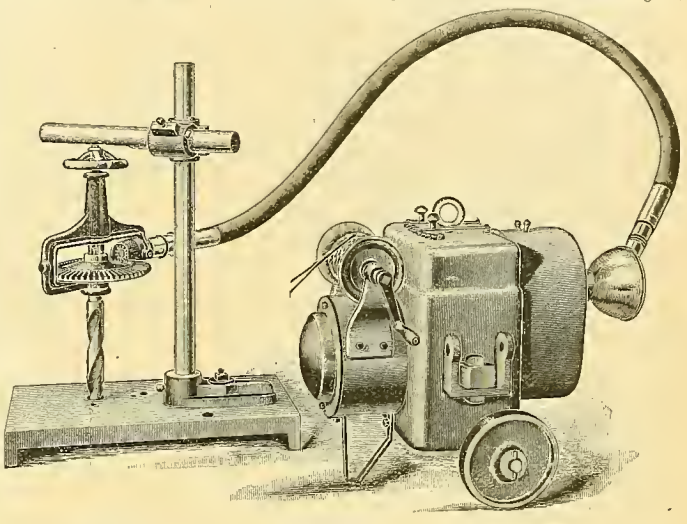
The size of the engine does not affect the efficiency greatly, as is the case with steam engines. Moderate-sized engines are practically as efficient as large ones. Very small engines (five horse power and less) have a somewhat lower efficiency.

The following description of a plant installed by the author may be of interest. The results noted may be easily duplicated by a similar installation, and by giving more particular attention to the points already noted, better results may easily be attained.

The conditions to be met were lighting a general store, with clerks to operate the plant and but little attention given by them. To prevent a higher rate of insurance the plant had to be located away from the building, but in reality a kerosene lamp is a more hazardous risk than the whole lighting plant.

The problem of choosing an engine was not a simple one. Engines governing by the "hit-and-miss" plan were avoided, heavy fly-wheels, and a simple, effective and reliable igniting apparatus being desirable. The Hornsby-Akroyd oil engine was chosen. The size is 10 brake horse power having a cylinder 11 inches in diameter and a stroke of 15 inches. The rated speed is 210 revolutions per minute, but it was found to give much steadier light and better regulation to run at 225 revolutions per minute. The kerosene is held in a tank which is cast in the sub-base of the engine. From this tank it is pumped into a hot chamber, called the vaporizer, which is bolted to the rear of the cylinder. There is a filter placed in the oil tank at the point where the oil leaves it to prevent the escape of dirt or grit, which would damage the check valves of the pump or prevent them from seating. The oil is injected into the vaporizer through two very small holes in the vaporizer valve box. This valve box is water jacketed to keep it cool. It is provided with a check valve that prevents the jar of the explosion from being communicated to the oil pipe or pump. This valve box is also provided with the by-pass valve that is operated by the governor. The oil flowing through this valve returns to the tank in the engine bed.

To start the engine, it is necessary first to heat the vaporizer. This is accomplished by burning about 1½ pints of kerosene in two lamps under the vaporizer. The fire is urged by a small blower. Six or seven minutes is sufficient time with this engine to heat the vaporizer so it will run; but after starting it takes about 10 minutes for the vaporizer to get hot enough to work its best. As soon as the oil is all burned out of the lamps the pump is worked by hand till the oil overflows at the by-pass valve. A lever is then moved that prevents the governor from coming into action till the proper speed is attained, and on turning the engine over it starts. There are no igniting devices save the heat from the vaporizing chamber and the heat of compression. There are no adjustments to be made except to alter the volume of the cylinder (which varies the amount of compression) by two very simple means. This change is necessary to adapt it to different oils.



IRON-CLAD ELECTRIC MOTOR COMBINED WITH FLEXIBLE SHAFT

With properly adjusted compression the explosions invariably occur on the dead center. Changing the temperature of the vaporizer from a black red to bright cherry red does not, so far as could be observed by the indicator, change the time of explosion.

The accompanying indicator cards were taken with a 60-pound spring, but an 80-pound spring would be better adapted to the work, because the pressure sometimes rises too near the limit at which it is safe to use the lighter spring. Card No. 1 is a good card and shows average working results. Card No. 2 shows the explosion line inclined instead of vertical. This condition prevails when there is too much oil injected in the cylinder, or when compression is not great enough. It indicates a slow burning, instead of an explosion, as in the case of the vertical line.

Iron-clad Electric Motor Combined with Flexible Shaft.

The Stow Manufacturing company of Binghamton, N. Y., manufactures the combination of motor and flexible shaft shown by the cut, which is especially valuable for portable drilling, tapping, reaming, emery-grinding, etc., wherever a source of electrical energy is available. The motor is iron-clad and is practically dust and water-proof. The frame is in the form of a hollow cube with inwardly projecting poles. In each end of frame is a circular aperture, over which is bolted the end plates supporting the bearings. One of these is extended into a short cylinder, forming a case for the commutator and brush-holder. The field coils are protected by metallic cases and can be easily removed. The motors below two horse power are bipolar and those of two horse power and over have four poles. The best of material is used in construction—self-oiling bearings, mica insulation, rheostats protected by iron case and covered gears. By simply changing the end plates, to bring the oil chambers below the bearings, the motor can be run in almost any position. Motors of this type can be furnished for direct connection when desired, and also for electric street railway track drilling. The portable motors, as shown, are fitted with truck wheels, leg, eye-bolt, side brackets, reel, 20 yards of insulated wire, and one set of reduction gears. By use of the speed regulator and gears almost any practical speed can be obtained. Motors wound for 110, 220, 500 or other voltages are furnished.

Electrical Designs for the Jubilee Illumination.

According to the London *Electrical Engineer* there seems to be no end of the designs for decorations for the forthcoming jubilee celebrations, and it is wonderderful what variation both in effect and workmanship is to be noticed in the resultant electric fittings compared with the leaky gaspipes which have previously been used. The illustrations show two designs made by the General Electric company. These are a marked contrast to many that have been presented, in that they are not of a temporary character. The whole of the

FIG. 1. ELECTRICAL DESIGNS FOR THE JUBILEE ILLUMINATION.

framework is heavy and substantial, so that the fitting could be used year after year. The first design, Fig. 1, consists of wreaths of flowers. The foliage is of metal work, suitably colored. The flowers have incandescent lamps as centers, while the surrounding petals are of colored glass variously tinted. The letters "V. R." in the center are brightly gilded, and the flowers around them cause them to stand out well when the design is lighted up. The complete arrangement extends about six feet in each direction. The total number of lamps on the design is 34, and, as a rule, they will be of 16 candle power.

The larger decoration, Fig. 2, measures about eight feet in height, and is nearly six feet broad. It is more elaborate in detail, and consists of a strong wrought-iron framework made hollow to receive the bulk of the

FIG. 2. ELECTRICAL DESIGNS FOR THE JUBILEE ILLUMINATION.

lamps. The fronts of these frames are covered by a fast-colored fabric, or by celluloid or glass, on which designs are worked representing the royal arms, with suitable inscription below. The floral wreath is constructed on the same principle as the first design, with metal foliage and glass letters. The crown above all is illuminated with small lamps of many colors to represent jewels; an oval in white lamps surrounds the coat-of-arms. The whole design takes about 20 small 10 volt lamps and 80 100 volt lamps of 16 candle power. Besides these two designs many others more simple in detail have been submitted. They consist of letters, crowns, stars, etc., formed by rows of lamps or of the usual crystal letters backed by electric lights, etc. Another novel feature is the use of lamps the upper zones only of which are dipped in colored varnishes. The lamps are then placed in metallic shades of the same color, only tinted more lightly. The uncolored portions of the lamps then reflect light on these shades, and give on the whole a gradation of color which is very effective. These shades can also be arranged in the form of letters. The use of lamps in colored celluloid spheres gives pleasing effects. The number of illuminated signs already constructed indicates that the celebration next month will prove profitable to central station men as well as designers.

Proposed New Electric Railway Between Niagara Falls and Buffalo.

At a meeting of the Common Council of Niagara Falls on Monday evening, May 17th, the Tonawanda Electric Railroad company made application for a franchise to extend its road through several streets of that city, thus showing that the Ely, or Buffalo and Niagara Falls railroad, is likely to have opposition between Buffalo and the Falls if the aldermen of Niagara Falls grant the franchise. The Tonawanda electric railroad is owned by George P. Smith, and for a long time it has been whispered that some day it would connect the Queen City and the Power City. Monday evening, June 7th, was fixed as the date for hearing the application. James H. Rand of Tonawanda is president of the company, and the application for a franchise states that it desires to run over the Packard road to Niagara street, crossing Sugar street above Echota, and coming into the city on Niagara street to the old Portage road, then north on the Portage road for one block to Ferry avenue and down Ferry avenue to Main street, where the tracks of the Niagara Falls and Suspension Bridge railway and the tracks of the Gorge road are crossed, and continuing from this point the proposed new line would occupy Main street to Niagara street, and Niagara for a block to the Riverway of the New York state reservation, which point is the entrance to Prospect Park, and also the end of the upper suspension bridge leading to Canada. Should the upper suspension bridge be replaced by a steel arch, as it is understood it will be this summer, the terminus of the road would be very desirable, for it would afford ready connection, without trespassing on the state reserve, with any line of tracks that might be built on the bridge to connect direct with a Canadian road, possibly shutting out other roads from the same connection, for the commissioners of the state reserve have refused to allow tracks to be laid on the Riverway or any portion of the great free park at Niagara.

It would appear that there is some understanding between the Niagara Falls Electric Railway company and the Tonawanda Electric Railroad company, for at the meeting of the council referred to Attorney Tuttle, representing the first named company, said it had decided to allow the matter of getting a franchise in Niagara Falls to drop. A little later he presented the application of the Tonawanda line for rights over some of the same streets covered by the application of the Niagara Falls Electric Railway company.

An Induction Coil for Electrical Measurements.

It is easy to transform induction coils of the ordinary form into delicate measuring instruments, says Albert Nodon, and then he proceeds to explain the proposed arrangement and use as follows:

If we place above an induction coil a magnetic needle, free to move in a horizontal plane, as shown in the cut, and then send a current of electricity through the coarse coil of the instrument after the needle has had time to settle, we will see that the needle will be deflected, and have a tendency to place itself parallel to the axis of the coils. Again, if a current is sent through the fine or secondary wire, we will also see a deflection. These movements of the needle may be controlled as to their amplitude by means of a dampening magnet placed over the needle. We thus create a magnetic field of variable intensity.

We now see that we can utilize the induction coil as either a voltmeter or an ammeter, for the former of these is but a fine-wire galvanometer, and the second a coarse-wire galvanometer; and by the use of both wires we will have a wattmeter.

The arrangement of the parts is readily seen. A base of wood supports two sliding rods, adjustable for perpendicular height. These rods form the supports for the needle, which can be adjusted for distance from the coils. A scale is shown upon which an indicating needle of aluminum traverses, this last being part of and attached to the magnetic needle, which is balanced on points, and has its length parallel to the indicating needle. The directing magnet is capable of being raised and lowered at will.

We can, with this instrument, test currents up to about 40 amperes by using the two uprights as terminals. The direction of the deviation of the needle also shows the direction of the current flow.

For intensities between five amperes and about $\frac{1}{100}$ of one ampere, send the current through the heavy wire of the coil. Then adjust the frame by sliding the supports up or down, and vary the distance of the director magnet.

For feeble currents, down to milliamperes, send the current through the fine wire. Adjust as before, but in a contrary sense.

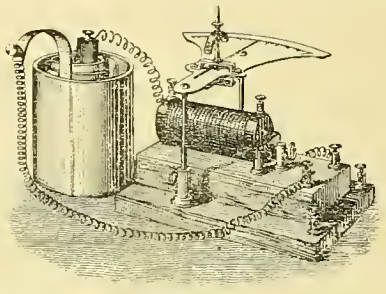
For use as an amperemeter there is within the base a German silver resistance measuring two ohms, which assists in the graduation. To accomplish this we use an ordinary lead accumulator cell of two volts, and of which the interior resistance is negligible. We pass the current at the same time through the resistance of two ohms and the large wire, the resistance of which is also negligible, and obtain, according to Ohm's law:

$$C = \frac{E}{R} \quad \text{or} \quad C = \frac{2 \text{ volts}}{2 \text{ ohms}} = 1 \text{ ampere.}$$

Then, for the intensity of one ampere (C), the needle stops at n, divisions of the graduated scale. Now, as in a tangent galvanometer, the deviations of the needle are proportioned, approximately, to the current flow; the standard being the ascertained deflection for one ampere, as we have just seen, it is easy to figure out the flow for a given deflection. The range of the instrument and the small compass make it extremely convenient as well as useful.

With a standard, either an accumulator or a Daniell cell, we may by using the fine wire get the known deflection of two volts or one volt of pressure by a similar process of proportion. In practice the accumulator cell is better, for the reasons that it can be used for both volt and ampere measurements, and also for actuating the coil as an induction instrument.

In connecting up the terminals so that the current is sent through both the large and small coils at the same time, after the interposition of the two ohms, we have



AN INDUCTION COIL FOR ELECTRICAL MEASUREMENTS.

again a proportional deflection of the needle, which indicates the watt energy. W = amperes into the volts, or W = 1 A × 2 V = 2 watts.

We see, then, that by the aid of this simple instrument we may effectually accomplish all the necessary measurements for ordinary electrical purposes where great accuracy is not required.

The amateur, who is often restricted financially as well as in the variety and quantity of apparatus, can in this single piece avail himself of its several purposes at a limited expense, for he will have at one and the same time for a minimum cost: First, a current indicator; second, a coarse-wire galvanometer; third, a fine-wire galvanometer; fourth, an amperemeter ranging in capacity from $\frac{1}{1000}$ to 50 amperes; fifth, a voltmeter ranging from 500 volts to $\frac{1}{100}$ volt; and sixth, a wattmeter.

Electric Traction for Suburban Railroads.

When the trolley cars begin running on the Batavia or Oak Park branch of the Chicago & Northern Pacific, electricity will have scored its first point in Chicago in the contest between steam and electricity as motive power on suburban lines. This rivalry, says the *Chicago Record*, is regarded as a matter of great importance with railroad men to-day. The successful third-rail experiments of the New England road within the last two weeks have given electricity a long lead, and when the directors of the Illinois Central give the word to Chief Engineer John Wallace to go ahead and equip the suburban lines between Randolph and Sixty-third streets with the third-rail system, the "juice," as railroad engineers call electricity, will be a winner. This is the opinion reluctantly expressed recently by the superintendents of motive power on half a dozen strong roads.

From all parts of the country come reports of the war which the electric motor is waging with the steam locomotive on suburban lines. In some instances the railroads have given in, and have adopted the "broomstick" engines. The New York Central is preparing to equip one of its suburban divisions with electric service. The conservative Lake Shore & Michigan Southern is in the heat of a fight with electric lines, which have stolen away considerable of its Cleveland suburban business.

This is a war of rates, but it is predicted that in a short time the Lake Shore either will adopt street-car methods with its steam service or else install the "juice." A hot fight is on in Detroit between steam and electric roads for suburban traffic, and the electric lines are ahead. The steam roads put on more cars and more trains, but they are handicapped, because their stations are too far apart and because trains are run by time-card.

In Chicago the electric lines reaching out into the sub-

urbs and paralleling the steam railroads have cut into the suburban business to such an extent that on some of the roads this business is given up. In the east, where cities and towns are close together, the electric railway lines have seriously affected the profits of steam railroads, which are gradually losing control of the short-distance suburban and interurban business.

Eastern railway men frankly admit that electricity soon will take the place of steam on many roads in Massachusetts, New York, Rhode Island, New Jersey, Connecticut and Pennsylvania. They say that the solution of the problem which confronts steam railroads in the retention of their local business lies in the adoption of electricity and the multiplication of stations. Some roads will adopt radical measures and change their steam equipment to electrical equipment. Other roads will parallel their lines with electric lines.

In Chicago the large roads having heavy suburban business are waiting to see what the Illinois Central will do. The elevation of railroad tracks will abolish grade crossings, and this one improvement will put most of the roads in a condition to equip their suburban lines with the third-rail system.

Fréne Current Controller.

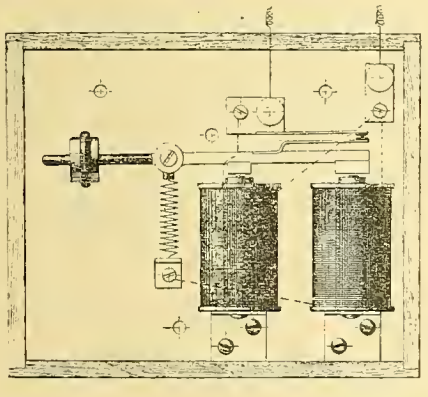
The normal amount of current for which the controller illustrated is adapted cannot be exceeded without detection, the object of the invention being to prevent use of an excessive amount of current, thus depriving legitimate lamps of voltage and reducing their candle power. Its use is confined principally to localities or installations where lamps are rented at so much a month, instead of being paid for by measure.

The apparatus is composed of two electro-magnets, one having a winding of insulated wire, the number of turns of which determines the output of current required through ohmic resistance, while the other is wound with fine wire and has a high resistance. Above these coils is seen an armature lever mounted on a pivot. To the left of the pivotal point the lever is threaded to allow a counterweight to properly balance the lever. The armature plates are of soft iron. Above the armature lever is a flexible spring forming a key contact when in a normal condition.

The device is inclosed in a box and the cover is fastened by a lock to prevent tampering with the regulation of the apparatus.

The introduction of lamps in excess of the agreed number for which the weight is set, reduces the resistance of the circuit and increases the current flow; the magnetism of the first magnet increases, overpowering the balance weight and breaking the contact. The current now passes only through the fine-wire magnet, and it holds the contact permanently open. A decided fall of potential results, which reduces the candle power of the lamps to virtual extinction.

As soon as the normal intensity of the current is restored by taking off the superfluous lamps, the reduced intensity of the current permits the balance to overcome the diminished power of the fine coil, and the current now takes its initial course through the contact points as before.



FRÉNE CURRENT CONTROLLER.

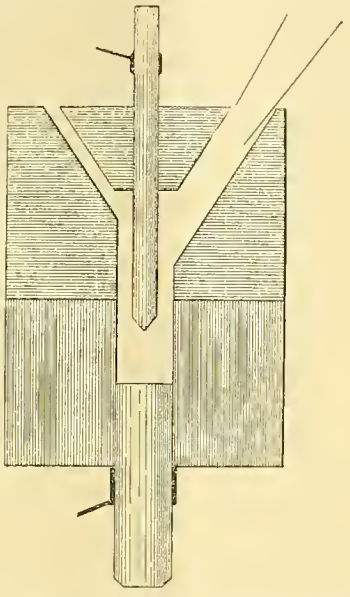
The illustrations are taken from *L'Electricien*.

The executive committee of the International Association of Police and Fire Telegraph Superintendents has decided to accept the invitation to visit Nashville, Tenn., for the next convention, and Tuesday, September 8th, was decided upon, this being the date of the Old Time Telegraphers' and the United States Military Telegraphers' meeting at the same place. The report of Treasurer Bosch shows the association to be in a good financial condition. The association is steadily growing in numbers. J. W. Aydon of Wilmington, Del., was elected a member of the executive committee.

An Electric Furnace for Experimental Work.

The accompanying illustration shows the principal features of a simple electric furnace designed by F. W. Küster and F. Bolezalek for experimental work, and is described by the inventors as follows:

The furnace can be made of the simplest materials, such as are available in every laboratory. Two large lumps of lime are procured, and from them are cut two rectangular blocks, one 15 centimeters or 20 centimeters square and 12 centimeters in thickness, the other of similar section and 14 centimeters in thickness. A hole four centimeters in diameter is bored through the middle of the lower block, and a cylindrical carbon rod is fitted to it closely. The carbon is thrust in as far as the middle of the thickness of the block, as shown in the figure, so as to leave a cavity having a capacity of about 75 cubic centimeters, serving as the chamber in which the reactions to be studied may take place. The upper block, which is the thicker of the two, serves as a lid. From its lower side a bore hole is started four centimeters in width and eight centimeters deep, acting as the upper half of the reaction chamber. This hole is continued of smaller diameter (1.5 centimeters) to receive the upper carbon electrode which fits with some friction so as to make a close joint. Two diagonal holes are also provided in this upper block, that on the left being for the escape of gas generated in the hearth of the furnace, and that on the right being designed as a hopper for feeding in the material to be treated: this latter is continued by a sheet-iron funnel. The surfaces of the lime blocks are made plane by grinding on a sandstone slab, and then further fitted by being rubbed together. It is easy to make in this way a joint which is nearly gas-tight. As the lime blocks are apt to crack when intensely heated internally, they should be strengthened by pieces of sheet-iron bent at a right angle and placed to protect each corner, the whole being then bound with iron wire into a compact block. Connection with the electrodes is made in the usual way, care being taken to have the conductor to the upper carbon bent in a large curve to permit free movement of the electrode in a vertical direction. The upper electrode may be conveniently held in a retort clamp with a long shank, so as to allow of adjustment even when it gets hot.



AN ELECTRIC FURNACE FOR EXPERIMENTAL WORK.

The furnace is used in the following way: The reaction chamber is partly filled with the material to be treated; the upper block is put in place; the upper electrode (which should be pointed) is pushed down until it touches the lower carbon; more material is filled in through the sheet-iron funnel until the funnel is full. The circuit is then closed and the upper carbon raised to start an arc. Using 36 secondary cells in series for each 180 ampere-hours required, the current can be so regulated by raising the upper electrode as to give a voltage at the terminals of 40 volts with a constant current of 60 amperes. In order to avoid an excessive current at first, a resistance (which can be cut out at will) of 0.36 ohm is interposed. The current can readily be adjusted so that the circuit cut-out designed to fuse at 75 amperes is never melted.

When the furnace has been started, carbon monoxide is given off at the opening, and should be kindled there; after running some time the gas if accidently extinguished will re-ignite of its own accord. Commonly the flame is about 30 centimeters long, and so brilliant from volatilized calcium as to make a blinding glare, and to need obscuring with a dark glass plate for the comfort of the operator. This is better than the use of dark spectacles, as these make the necessary manipulations and reading of the instruments difficult. The point when the first charge has been run down can be detected by the diminution of the flame from the vent of the furnace, and a fresh quantity may be introduced by raising the upper carbon so as to diminish the current passing, breaking any crust which may have formed over the lower end of the feeding hopper by means of a rod of porcelain or pipe-clay, then lowering the carbon until the full current is restored, the new material being thrust in little by little down the funnel. The length of the flame of the escaping gases serves as an index of the progress of the reaction within. When the operation takes more than about half an hour it may happen that the vent-hole for gas becomes stopped with volatilized products; in this case the obstruction must be removed by the use of a clay rod thrust in, and quickly withdrawn lest it melt. It is possible to fuse a charge of 500 grammes in half an hour to one hour, without noteworthy loss. After the furnace has been shut down, about an hour must elapse before it can be handled, but it is instructive to raise the upper block for a moment to get a glimpse of the intense white heat of the reaction chamber.

It is desirable to use the furnace under a hood with a good draught, but for short runs it can be used in the open laboratory without serious inconvenience.

Indiana's Three-cent Fare Law.

The question of the validity of the three-cent law passed by the last General Assembly of Indiana, the provisions of which were applicable only to Indianapolis, was argued last week before the Supreme Court of Indiana.

During the recent street railway contention in Indianapolis, and after Judge Showalter of the United States Circuit Court, Chicago, had enjoined the city from undertaking the enforcement of the law, a test case was made by prosecuting a local resident under the city ordinance making it a misdemeanor to refuse to pay five cents fare on a street car. The defendant was fined despite his plea that the so called three cent law was a good defense to the prosecution. The city testified that this law was unconstitutional, and the appeal followed.

The attorneys of the street railway company declined to recognize the proceedings. The city attorney conducted the case and pleaded that the act was class legislation, while the attorney-general of Indiana appeared in defense of the enactment, and in his argument gave much attention to the Showalter ruling, insisting that so far from being bound by the United States Circuit Court, the final decision in the higher federal court will be governed by the law declared by the state Supreme Court, as recently shown in the Hammond annexation cases. A ruling of the Supreme Court is anticipated before the summer vacation, next month.

Meetings of Niagara Power Companies.

A meeting of the stockholders of the Niagara Falls Power company has been called for 11 A. M., June 1st., at the company's office in Niagara Falls. At this meeting the stockholders will be called upon to take action on a proposition to increase the company's capital stock from $3,000,000 to $3,500,000, the increase to consist of 5,000 shares at a par value of $100 each.

On the same day and at the same place will be held the annual meeting of the stockholders of the Niagara Falls Power company for the election of nine directors and two inspectors of election for the ensuing year, and also for the consideration of such other business as may properly come before the meeting. The transfer books, which closed May 25th, will be re-opened on June 2d.

The annual meetings of the Niagara Development company and the Niagara Junction Railway company, allied companies of the Niagara Falls Power company, will be held on the same day and at the same place.

The result of an election at Chester, S. C., will be the bonding of the town for $50,000 for electric lights and waterworks. P. M. Spratt is the mayor.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 16,630.

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AFTER many years of strife, which too often has been very bitter, the citizens of Toronto, Ont., on Saturday, May 15th, voted in favor of having street cars run on Sunday. The total vote cast was 32,387, and the majority recorded in favor of Sunday cars was only 479. Toronto is now expected to take its place in line with other progressive cities.

WE commend to the thoughtful consideration of our contemporaries of the daily press the words of wisdom contained in a brief editorial reproduced on another page of this issue from the *Chicago Chronicle*, in which the city of New York is congratulated upon the decision of judge in that state that the municipality is debarred from purchasing a certain street-car line in the metropolis. It is pointed out that municipal ownership is an unmitigated evil, and that there is altogether too much paternalism in the country at present. The tendency in that direction should be effectually checked and movements like the one under consideration discouraged. This is a common-sense view of the situation that it would be well for the public to appreciate and accept.

AT last the programme for the Niagara meeting of the National Electric Light association has been issued, and its promises for an interesting and instructive convention are very attractive indeed. The only thing that can be said about it is that it is to be regretted that the announcement was not made earlier in order to give those who are interested in the subjects to be presented a better opportunity to prepare for the discussion. The management is to be congratulated, however, upon the improvement in its record over last year. Possibly another year or two may see the organization so perfected that the programme can be issued a month or six weeks in advance of the meeting. Encouragement in bringing this about will not be wanting. All seem to realize the necessity of this change, excepting those having the matter in charge.

CAREFUL examination of the text of the opinion of Justice Brewer of the Supreme Court of the United States confirms the views expressed by this journal on May 15th, when announcement was made of the decision in the Berliner case. The action of the court was based upon the contention that the government had not proven its charges of corruption and collusion between the officers of the Patent Office and the American Bell Telephone company, and that other matters in dispute could be adjusted in the ordinary way when the Bell company attempted to enforce the patent. Read in the light of experience it is evident that the Bell company's sole aim at the present time is to gain some temporary advantage, possibly with the hope of extorting from the independent companies compensation in the form of licenses or royalties for being permitted to continue in business unmolested so far as the Berliner patent is concerned. This would explain its policy in resorting to every technicality known to experienced practitioners in order to evade a direct consideration of the patent and a decision upon the value and scope of the invention. Assuming that this course was prompted by ultra-conservatism and not by fear, what lasting advantage does the Bell company secure through its victory? None whatever, so far as can be learned by outsiders. If its patent be proven valid and valuable, eventually, it has only extended the term of activity of its rivals and incurred great expense in sustaining through other litigation the claims of the patent that might have been submitted at this time to the highest tribunal in the land. On the other hand, however, it cannot hope to bluster and browbeat into submission the independent companies that are already established if its claim to monopoly cannot be sustained in court, as the anti-Bell forces are too well organized to be thus overthrown. It will, it is true, enable the parent company to extort royalties from local Bell exchanges for several years, even though the Berliner patent might be annulled when considered upon its merits. But such action would ultimately bring upon those responsible for it such severe censure and reproach as to make the proceeding unprofitable as well as unsatisfactory.

AS COMPETITION in the telephone business increases, the points decided by the Supreme Court of Illinois last month in the case of the Cairo Telephone company against the Western Union Telegraph company will increase in importance. Here was an attempt on the part of the telephone company just named to compel the telegraph company to permit it to put one of its telephones in a telegraph office at Cairo, Ill., and to compel the telegraph company to receive telegraph messages from, and transmit telegraph messages to, its subscribers, by means of its telephone exchange, in the same manner that the telegraph company received messages from, and transmitted them to, subscribers of the Central Union Telephone company, which used the telephones of the American Bell Telephone company. But the Supreme Court denied that the telegraph company could be compelled by mandamus to do this. It said that the latter was bound to treat all persons and corporations alike, and without discrimination, in its business of receiving and transmitting messages by telegraph, but it added that the latter undoubtedly had a right to choose its own agencies for the performance of its duties, and was not bound to admit to its service every person or corporation who desired to assist in such performance or act as such agency. Such a choice was not a discrimination between persons or corporations in respect to a matter where they had any right or the telegraph company owed any duty. Because one messenger boy was employed to carry messages to the persons to whom they were directed, it could scarcely be said that the duty to treat all persons alike in serving the public required that every other boy having equal physical ability to carry messages, who might offer himself for the service, must be employed. Moreover, aside from the question whether the telegraph company owed any duty to the public or to the Cairo Telephone company to furnish office room and attend the telephone, the Supreme Court held that it was not bound to receive verbal messages. Nor did it consider that because it had waived its rights in that respect in dealing with one telephone company a like waiver on its part to the Cairo company was required. It might be willing to assume risks with one telephone company that it would not with another. And a statute imposing penalties for the refusal of a telegraph company to receive or transmit any dispatch from any other telegraph company, the court held, did not require a compliance with the demands in this case.

IF evidence were wanting of the effect of legislative or litigious action upon street railway securities, it could be found in abundance in the quotations of the stock markets during the last month, both in Chicago and New York. No matter what opinion may be entertained of the advisability of listing these securities, it must be admitted that the fluctuations in values noted are an unmistakable reflection of public opinion concerning them. In New York the controversy over the rights of the surface companies, and the threatened opposition to the elevated roads, have had a depressing effect upon the stocks of these corporations. The same experience was noted in Chicago during the discussion of the Humphrey bills and immediately following their defeat. In spite of every effort to bolster up these securities, they dropped several points, and all the wild rumors circulated in Springfield and upon La Salle street could not quicken them into activity. It remains to be seen what effect the Littler bills will have upon them. This measure presents an entirely different proposition from that embodied in the late Humphrey bills. It says nothing about a state commission to grant franchises for the use of Chicago streets; it says nothing about the rate of fare that shall be charged by the street railways; it does not seek to hamper street railway companies that may be organized after the bill shall have gone into effect, and it does not say anything about the compensation that the city shall receive for the use of its thoroughfares. As compared with the Humphrey bills the new measure makes many concessions to public opinion, and indicates that the street railway men appreciate the fact that they are in the position of suppliants for public favors, not dictators of terms upon which they will provide transportation facilities. Had they come into this frame of mind earlier they might now have less trouble in convincing Chicago that it would be for the interest of the people as well as for the corporations to place these enterprises upon a firm and substantial footing. This is certainly very desirable, and it can only be done by increasing the legal time for street railway franchises which local authorities are now limited in granting, and legalizing the operation of electric and cable cars. The present "horse and dummy" railway act, under which all the Chicago street railways, with but one exception, hold charters, permits the granting of franchises for but 20 years, and gives no authority for operating anything but horse and dummy lines. "Dummy" means "small steam locomotive," according to the legal interpretation of the statute, and the act therefore, it is contended, gives no authority for the operation of cable and trolley lines. If this be true the lines of electric and cable road now operating in Chicago are in each case exceeding their charters.

Senator Littler's bill empowers the City Council to grant franchises for a long term and recognizes street railways of all classes. It is a substitute for the "horse and dummy" act, broadens the definition of the term "street railway" and makes franchises extending over a greater period possible. To secure these long-term franchises the Chicago street railways will, under the proposed law, have to deal with the City Council as heretofore, or, as Mr. Yerkes says, the street railway companies will have to submit to a revision of their property at every meeting of the City Council.

SUPREME COURT DECISION.

Full Text of Justice Brewer's Opinion in the Berliner Case.

When the decision of the Supreme Court of the United States in the suit of the Government to have the Berliner patent set aside was announced on Monday, May 10th, the points considered by Justice Brewer, who submitted the opinion, were made public, but the opinion itself was not given out, as it had not been printed. A certified copy of the opinion has just been received from Washington, and it is here reproduced in full.

A careful examination of this document reveals the fact that there is much in the decision that will reassure the independent manufacturers of telephone apparatus and owners of anti-Bell exchanges. The court takes particular pains to point out that many considerations which it could not admit in the government suit may properly be introduced as defenses when the Bell company may attempt to sustain the patent. The opinion confirms the belief, too, that the so-called victory of the Bell interests is in reality a skillful evasion on technical grounds of the real point at issue. Following is the complete text of this important document:

On February 1, 1893, the United States filed in the Circuit Court of the United States in and for the District of Massachusetts a bill in equity against the American Bell Telephone company and Emile Berliner, praying a decree to set aside and cancel patent No. 463,569, issued on November 17, 1891, to the telephone company, as assignee of Berliner. Upon amended pleadings and proofs the Circuit Court on January 3, 1895 (65 Fed. Rep. 86), entered a decree as prayed for. On appeal to the Court of Appeals for the First Circuit this decree was on May 18, 1895, reversed, and a decree entered directing a dismissal of the bill. (33 U. S. App. 236.) Thereupon the United States took an appeal to this court. A motion was made to dismiss the appeal for want of jurisdiction, which was denied (159 U. S. 548), and the case was argued upon the merits.

As stated by counsel for the appellant, four grounds for relief were presented and discussed in the Circuit Court. Those grounds are:

"1. That the delay of the application in the office for 13 years was, under the circumstances alleged in the bill, unlawful and fraudulent.

"2. That a patent issued November 2, 1880, upon a division of the original application, covers the same invention as that covered by the patent in suit, and exhausted the power of the commissioner as to that invention.

"3. That the patent is not for the same invention which was described in the application as filed.

"4. That, taking the application to date from the time when it was made by amendment to cover the invention described and claimed in the patent as issued, it was barred by public use for more than two years."

By that court only the first two were considered, and the argument in the Court of Appeals was confined to those questions.

Mr. Justice Brewer delivered the opinion of the court:

This is a suit by the United States to set aside a patent for an invention as wrongfully issued. It is, we believe, the first case in this court in which upon proofs such an application has been presented. The right of the United States to maintain such a suit was affirmed in United States vs. Telephone company (128 U. S. 315). The question now is whether upon the facts disclosed in this record the relief prayed for ought to be awarded. It becomes, therefore, a matter of moment to determine under what circumstances and upon what conditions the United States are entitled to have a patent issued in due course of law set aside and canceled.

Many cases have come to this court, in which patents for lands have been sought to be set aside, and the rules controlling such suits have been frequently considered. Such decisions will naturally throw light upon the question here presented, though before adverting to them it may be well to note the difference between patents for land and patents for inventions. While the same term is used, the same grantor is in each, and, although each vests in the patentee certain rights, yet they are not in all things alike. The patent for land is a conveyance to an individual of that which is the absolute property of the Government and to which, but for the conveyance, the individual would have no right or title. It is a transfer of tangible property; of property in existence before the right is conveyed; of property which the Government has the full right to dispose of as it sees fit, and may retain to itself or convey to one individual or another; and it creates a title which lasts for all time. On the other hand, the patent for an invention is not a conveyance of something which the Government owns. It does not convey that which, but for the conveyance, the Government could use and dispose of as it sees fit, and to which no one save the Government has any right or title except for the conveyance. But for the patent the thing patented is open to the use of anyone. Were it not for this patent anyone would have the right to manufacture and use the Berliner transmitter. It was not something which belonged to the Government before Berliner invented it. It was open to the manufacture and use of anyone, and anyone who knew how could contrive, manufacture and use the instrument. It conveyed to Berliner, so far as respects rights in the instrument itself, nothing that he did not have theretofore. The only effect of it was to restrain others from manufacturing and using that which he invented. After his invention he could have kept the discovery secret to himself. He need not have disclosed it to anyone. But in order to induce him to make that invention public, to give all a share in the benefits resulting from such an invention, Congress, by its legislation, made in pursuance of the constitution, has guaranteed to him an exclusive right to it for a limited time; and the purpose of the patent is to protect him in this monopoly, not to give him a use which, save for the patent, he did not have before, but only to separate to him an exclusive use. The Government parted with nothing by the patent. It lost no property. Its possessions were not diminished. The patentee, so far as a personal use is concerned, received nothing which he did not have without the patent, and the monopoly which he did receive was only for a few years. So the Government may well insist that it has higher rights in a suit to set aside a patent for land than it has in a suit to set aside a patent for an invention. There are weightier reasons why the Government should not be permanently deprived of its property through fraudulent representations or other wrongful means, than there are for questioning the validity of a temporary monopoly or depriving an individual of the exclusive use for a limited time of that whose actual use he claims to have made possible, and which, after such time, will be open and free to all. Bearing in mind this distinction, let us inquire upon what conditions the Government may maintain a suit to set aside a patent for land.

These suits may be conveniently grouped in three classes: First, where, the Government being the only party interested, the patent is charged to have been obtained by fraud in representations or conduct. Second, where the land by appropriate reservation is not subject to patent, but is, nevertheless, erroneously patented. Third, where the land, though subject to patent in the ordinary administration of the land office, is patented to the wrong person either through fraud or by reason of mistake or inadvertence. In the first class are the following cases: United States vs. Hughes (11 How. 552); United States vs. Throckmorton (98 U. S. 61); United States vs. Atherton (102 U. S. 372); Moffat vs. United States (112 U. S. 24); United States vs. Minor (114 U. S. 233); Maxwell Land Grant Case (121 U. S. 325); Colorado Coal Co. vs. United States (123 U. S. 307); United States vs. San Jacinto Tin Co. (125 U. S. 273); United States vs. Silver Mining Co. (128 U. S. 673); United States vs. Hancock (133 U. S. 193); United States vs. Trinidad Coal Co. (137 U. S. 160); United States vs. Budd (144 U. S. 154); San Pedro &c. Co vs. United States (146 U. S. 120). In the second are these: United States vs. Stone (2 Wall. 525); Leavenworth &c. R. R. Co. vs. United States (92 U. S. 733); McLaughlin vs. United States (107 U. S. 526); Western Pacific R. R. Co. vs. United States (108 U. S. 510); Mullan vs. United States (118 U. S. 271); and in the third the following: Hughes vs. United States (4 Wall. 232); United States vs. Beebe (127 U. S. 338); United States vs. Marshall Mining Co. (129 U. S. 579); United States vs. Missouri &c. Railway (141 U. S. 358); United States vs. Southern Pacific R. R. Co. (146 U. S. 570).

The second and third classes are not paralleled in this case, for it is not claimed that there was no invention, or that the patent issued to the wrong party. The decisions in those classes need not be considered. The first class comprises all cases in which the land, though subject to patent and therefore within the jurisdiction of the land department, was charged to have been patented in consequence of fraudulent representations or conduct on the part of the patentee. The representations may have been as to the matter of right or the matter of quantity. The patentee may have been entitled to no land or to less, or a different tract than that patented. In any event, fraud was the basis of the relief sought, and as fraud actual or constructive in the issue of the patent is the burden of this suit, we will quote from the opinions in some of these cases. In the Maxwell Land Grant case, Mr. Justice Miller, delivering the opinion of the court, said (page 381):

"We take the general doctrine to be, that when in a court of equity it is proposed to set aside, to annul or to correct a written instrument for fraud or mistake in the execution of the instrument itself, the testimony on which this is done must be clear, unequivocal and convincing, and that it cannot be done upon a bare preponderance of evidence which leaves the issue in doubt. If the proposition, as thus laid down in the cases cited, is sound in regard to the ordinary contracts of private individuals, how much more should it be observed where the attempt is to annul the grants, the patents, and other solemn evidences of title emanating from the Government of the United States under its official seal. In this class of cases, the respect due to a patent, the presumption that all the preceding steps required by the law had been observed before its issue, the immense importance and necessity of the stability of titles dependent upon these official instruments, demand that the effort to set them aside, to annul them, or to correct mistakes in them should only be successful when the allegations on which this is attempted are clearly stated and fully sustained by proof. It is not to be admitted that the titles by which so much property in this country and so many rights are held, purporting to emanate from the authoritative action of the officers of the Government, and, as in this case, under the seal and signature of the president of the United States himself, shall be dependent upon the hazard of successful resistance to the whims and caprices of every person who chooses to attack them in a court of justice; but it should be well understood that only that class of evidence which commands respect, and that amount of it which produces conviction, shall make such an attempt successful."

In Colorado Coal company vs. United States, Mr. Justice Matthews, after quoting part of the foregoing, adds (p. 317):

"It thus appears that the title of the defendants rests upon the strongest presumptions of fact, which, although they may be rebutted, nevertheless can be overthrown only by full proofs to the contrary, clear, convincing and unambiguous. The burden of producing these proofs and establishing the conclusion to which they are directed rests upon the Government. Neither is it relieved of this obligation by the negative nature of the proposition it is bound to establish. It is, indeed, sometimes said that a negative is incapable of proof, but this is not a maxim of the law. In the language of an eminent text writer: 'When the negative ceases to be a simple one—when it is qualified by time, place or circumstance—much of this objection is removed; and proof of a negative may very reasonably be required when the qualifying circumstances are the direct matter in issue, or the affirmative is either probable in itself, or supported by a presumption, or peculiar means of proof are in the hands of the party asserting the negative.'"

Then, after quotations from many authorities, the learned justice closes the discussion with these words from 1 Greenleaf on Ev. sec. 80:

"So, where the negative allegation involves a charge of criminal neglect of duty, whether official or otherwise; or fraud; or the wrongful violation of actual lawful possession of property; the party making the allegation must prove it; for in these cases the presumption of law, which is always in favor of innocence and quiet possession, is in favor of the party charged."

In United States vs. Marshall Mining company, Mr. Justice Miller again refers to this matter, saying (p. 589):

"The dignity and character of a patent from the United States is such that the holder of it cannot be called upon to prove that everything has been done that is usual in the proceedings had in the land department before its issue, nor can he be called upon to explain every irregularity or even impropriety in the process by which the patent is procured."

With these declarations of the law controlling such cases we proceed to consider that which, according to the brief of counsel for the Government, is the principal matter in this case. We quote their words:

"The delay in the office is the great fact in the case. It determined the bringing of the suit, stands in the forefront of the bill, was the principal question argued in both courts below, and occupies the chief space in the decisions rendered. It is not set up as laches, nor as a ground of forfeiture under any provision of the law or rule of the Patent Office, but as a course of conduct in the nature of fraud on the public."

What was the delay in this case? The application by Berliner was made on June 4, 1877, he having filed a caveat on April 14, 1877. In 1878, and prior to October 23, the telephone company purchased Berliner's invention, and on November 17, 1891, a patent was issued to the telephone company, as assignee of Berliner. The application was, therefore, pending in the department fourteen years, during thirteen of which the invention was the property of the telephone company. The effect of this, it is said, is to prolong for all practical purposes the telephone monopoly during the lifetime of this patent; and in this way: On March 7, 1876, patent No. 174,465 was issued to Alexander Graham Bell, in which patent, as alleged in the bill and admitted in the answer, were described and claimed "a method of and apparatus for transmitting sound by means of an undulatory current of electricity." This was the original telephone patent. And it signified that Bell invented the telephone. That patent has expired and all the monopoly which attaches to it alone has ceased, and the right to use that invention has become public property. But while he invented the telephone, the apparatus he devised was inefficient for public uses. Berliner invented something by which, taken in connection with Edison's and Blake's inventions, Bell's undulatory current could be made practically available for carrying on conversation at long distances. In other words, the telephone, as we use it—that which has become such an important factor in the commercial and social life of to-day—does not embody simply the invention of Bell, but also those of Edison, Blake and Berliner. So that while the public has to-day, by reason of the expiration of the Bell patent, the right to use as it pleases his invention, such right is a barren one, and the telephone monopoly is practically extended to the termination of the Berliner patent. And this extension of the time of the monopoly has been accomplished by means of the delay in the issue of the Berliner patent, the long pendency of the application in the Patent Office. In order that the contention of the Government may be clearly presented, and in view of the importance of this question, we may properly quote at some length from the brief of counsel:

"In the present case Mr. Bell's patent of 1876 covered broadly the process of transmitting sound by means of an undulatory electric current, as distinguished from an interrupted or broken current, no matter how produced. His patent showed a transmitter capable of producing such a current, but so feebly that its use was limited to short distances. Afterward Mr. Berliner discovered, we will say, that the undulatory current necessary to transmit speech can be produced by means of another form of transmitter—one operating by variation of pressure between its electrodes at their point of contact. But as the only function of the instrument was to produce an undulatory current, and as the use of that current, however produced, was covered by Mr. Bell's invention, it follows that the instrument was subject to two independent monopolies.

"Later, we will say, Mr. Edison discovered that the use of carbon as the material for the construction of the electrodes of the Berliner transmitter gave to that instrument a greatly increased power and reach of operation. Later still Mr. Blake devised a particular combination of carbon and metallic electrodes, with mechanism for their mounting, which secured an improved ease and permanence of adjustment and superior adaptation to common use. Mr. Bell hit upon the true principle, in relation to the kind of current to be employed, and was justly entitled to a patent for it, although the range of his transmitter may have been but a few hundred feet. Mr. Berliner, we will say, hit upon the true principle underlying the operation of the microphone, and was entitled to his patent, although the mechanism he used in the embodiment of his thought was so unstable in its adjustment as to make it of uncertain value. The inventions of Mr. Edison and Mr. Blake completed the instrument, and made possible the talking telephone in every man's house, the city exchange, and the long-distance line from city to city.

"It thus hapened that the Blake transmitter introduced into public use by the Bell company in 1878, and familiar to us all, was the embodiment in one piece of mechanism, and its use of four distinct inventions made by four different men. That company was the owner of all the inventions. For Mr. Bell's invention it held patents issued in 1876 and 1877; for Mr. Blake's patents were issued in 1881; and for the others, applications were on file subject to its control.

"Mr. Bell's invention was one of the first rank—nothing less than the discovery of a new law of nature. Mr. Berliner's invention was a beautiful intellectual conception of a mode of operation. Mr. Edison's was the discovery of a new property of carbon. Mr. Blake's was an ingenious and a practical utilization of the three. Mr. Bell's invention lies at the foundation of the art of telephony. Mr. Edison's and Mr. Blake's have done more to make the art of practical value than all others following Mr. Bell.

"We assume that it was not possible to take out patents for all these inventions at the same time. And so far as that was not possible, the overlapping and prolongation of the monopolies created by the patents in the use of the carbon microphone could not be avoided without denying to some one or more of the inventors his rights under the law. But does it follow that the Bell company was entitled of right to hold control of the microphone under the broad claims of the Bell patent and the construction and combination claims of the Blake patents, and nurse the applications for the other inventions in the office, taking out a patent on Berliner's just in time to overlap Bell's, and on Edison's in time to overlap Berliner, and so secure a monopoly on the same transmitter used in the same way to produce the same result for three times the period fixed by the statute for the duration of a patent?

"It needs no lawyer's argument to make manifest the inherent moral wrongfulness of such a proceeding toward the public. Every right-minded man will feel it instinctively. Would it be a legal wrong?"

After discussing the injury to the public which results from the conduct described, they add:

"Hence a man who is enjoying a monopoly of a thing under one patent, and is at the same time prosecuting an application for another patent which will give him a monopoly of the same thing for a further period, is bound to speed his application."

It will be perceived that it is conceded that some delay is unavoidable. In the very nature of things that is so. It is not possible that an application for a patent can be considered and determined on the instant. So it is not the fact, but the excessiveness of the delay of which complaint is made. The mere fact of delay does not, therefore, operate to deprive the inventor of his legal rights. Before he can be punished it must be shown that he has been guilty of a wrong—that he has caused the delay. It matters not whether the delay be reasonable or unreasonable, for a brief time or for many years, if the applicant is not responsible for it. Whatever may be the injury to the public, if the delay is caused solely through the negligence or inattention of the tribunal before which the application is pending, it is something for which the applicant is not responsible, and which does not affect his legal rights. There is often great delay in suits in the courts. Cases not infrequently are argued before the highest courts and not decided by

them for weeks and sometimes for years. Whatever effect such delay may have upon the interests of others or of the public, so long as it results from the mere nonaction of the courts, the rights of the suitor are unaffected. He cannot be punished on account of the delay of the tribunal before which he is presenting his suit.

Neither can a party pursuing a strictly legal remedy be adjudged in the wrong if he acts within the time allowed, and pursues the method prescribed by the statute. If the statute gives him five years within which to bring an action on a note he cannot be denied relief simply because he waits four years and eleven months. If he has two years after a judgment against him within which to take an appeal he may wait until the last day of the two years. Under Section 4886, Rev. Stats., an inventor has two years from the time his invention is disclosed to the public within which to make his application, and unless an abandonment is shown during that time he is entitled to a patent, and the patent runs as any other patent for seventeen years from its date. He cannot be deprived of this right by proof that if he had filed his application immediately after the invention the patent would have been issued two years earlier than it was, and the public therefore would have come into possession of the free use of the invention two years sooner. The statute has given this right, and no consideration of public benefit can take it from him. His right exists because Congress has declared that it should. It will not do to say that, because Congress has declared that seventeen years is the life of a patent, seventeen years is the limit of the possible monopoly; for the same legislation that gives seventeen years as the life of a patent gives two years within which an application for a patent may be made, and during that time, as well as while the application is pending in the department, the applicant has practically, if not legally, an exclusive use. A party seeking a right under the patent statutes may avail himself of all their provisions, and the courts may not deny him the benefit of a single one. These are questions not of natural but of purely statutory right. Congress, instead of fixing seventeen, had the power to fix thirty years as the life of a patent. No court can disregard any statutory provisions in respect to these matters on the ground that in its judgment they are unwise or prejudicial to the interests of the public.

And in this connection it is also well to notice these facts: Section 4888, Rev. Stat., requires an inventor to make application in writing to the commissioner of patents. That and the two or three succeeding sections prescribe what the application shall state, and by what it shall be accompanied. Section 4893 provides that on the filing of the application and the payment of fees "the commissioner of patents shall cause an examination to be made of the alleged new invention or discovery; and if on such examination it shall appear that the claimant is justly entitled to a patent under the law, and that the same is sufficiently useful and important, the commissioner shall issue a patent therefor." Section 4894 reads:

"All applications for patents shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within two years after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the commissioner of patents that such delay was unavoidable."

Certain rules of procedure have been prescribed by the commissioner of patents, and a certain routine of practice has become established in that department. Now, all these matters of statutory enactment, rules of procedure and routine of practice are things over which an applicant has no control. When he has once filed his application, complying with the statutory requirements, then the Patent Office takes possession of the matter. It determines when and how it will act, and the applicant can only ask and wait.

And why should he be called upon to do more? He comes before the tribunal which the Government has established and presents his application. Why should the validity of the grant which that tribunal finally makes depend in any degree upon the number of times he has repeated his application? The true rule is that if application has been made and the applicant has once called for action, he cannot be deprived of any benefits which flow from the ultimate action of the tribunal, although that tribunal may unnecessarily, negligently, or even wantonly, if that supposition were admissible, delay its judgment. If the public is interested in prompt action, if the Government which represents the public thinks that more speed on the part of any of its tribunals is essential, it is the Government which is called upon to act, and the applicant may with propriety wait until either the tribunal has acted or until the Government, having regard for the public interest, has interfered to compel action. Accepting the statement of counsel as to the facts to be correct in all its fullness, consider what would have been the ruling of a court if an application had been made to it based upon those facts. Suppose the applicant had presented its petition for a mandamus to compel prompt action on the part of the patent officials and said, "I have applied for and am entitled to a patent. It will be issued after a while without any judicial compulsion. I can make large profits if the Patent Office will be dilatory, and yet I ask a mandamus to compel its immediate action," would not the ruling have been, "By your own showing you are entitled to no relief; you have no cause of complaint; it is the Government, representing the public, which alone can complain." And if it could obtain no assistance by a suit in advance, can it be punished indirectly by being deprived of that which was finally awarded to it?

Much is said in the briefs and in the arguments about the practical continuance of the telephone monopoly. It is well to understand exactly what is meant thereby. No one questions that the Bell patent has expired, and that all of his invention is free to the use of the public. It is not denied that Berliner's invention is something independent and distinct from the Bell invention. It is the combination of these inventions with those of Blake and Edison which makes the instrument in commercial use, and because this is the most serviceable it is the one that the public insists upon having. But each invention has independent rights. It loses nothing because when united with another it results in an instrument more valuable than either alone will give. Suppose that at the expiration of this Berliner patent some new invention shall be made by which in connection with those already free to the public an instrument can be manufactured far surpassing in utility that used to-day, and the Bell company shall purchase that invention, the public, which always insists on having the best and most serviceable, will undoubtedly take the new instrument, and in that way it may happen that what is called the telephone monopoly is practically still further continued. But surely that does not abridge the legal rights of anyone. The inventor of the latest addition is entitled to full protection, and if the telephone company buys that invention it is entitled to all the rights which the inventor had. All that the patent law requires is that when a patent expires the invention covered by that patent shall be free to everyone, and not that the public has the right to the use of any other invention, the patent for which has not expired, and which adds to the utility and advantage of the instrument made as the result of the combined inventions.

Counsel seem to argue that one who has made an invention and thereupon applies for a patent therefor occupies, as it were, the position of a quasi trustee for the public; that he is under a sort of moral obligation to see that the public acquires the right to the free use of that invention as soon as is conveniently possible. We dissent entirely from the thought thus urged. The inventor is one who has discovered something of value. It is his absolute property. He may withhold the knowledge of it from the public, and he may insist upon all the advantages and benefits which the statute promises to him who discloses to the public his invention. He does not make the law. He does not determine the measure of his rights. The legislative body, representing the people, has declared what the public will give for the free use of that invention. He cannot be heard in the courts to say that it is of such value that he is entitled to a larger and longer monopoly; that he is not fully compensated for the great benefit which his invention has bestowed by the pecuniary receipts during seventeen years. No representative of the public is at liberty to negotiate with him for a new and independent contract as to the terms and conditions upon which he will give up his invention. He must come under the dominion of the statute, and take that which the public has proffered its willingness to give. As the lawmaking power has prescribed what the public will give, specified the terms and conditions of purchase, indicated the time and methods of determining the right of compensation, he on his part has an absolute legal right to avail himself of all the provisions thus made. It is not of course doubted that the courts, in construing the patent as all other statutes, must have regard to the spirit as well as the letter. That simply requires that courts shall ascertain their true meaning, but when that is ascertained the applicant for a patent is entitled to all the benefits which those statutes thus construed give.

What are the evidences of wrong in this matter of delay? It may have been caused either by the negligent or wrongful action of the officers of the department, and without any connivance, assistance or concurrence on the part of the applicant, or it may have been brought about by the applicant, either through its corruption of the public officers, or through other misconduct on its part. If the fault is wholly that of the department, the applicant ought not to suffer therefor. While, on the other hand, if its conduct has been wrongful, it may and ought to suffer. There is no presumption against the applicant. If a tribunal charged with official action delays such action, whatever of presumption surrounds the delay attaches to the tribunal, and no evidence of wrong being given, the presumption would be that the delay was at the instance of the tribunal and not caused by the applicant. The Government, therefore, in order to make out its case, must affirmatively show that the delay has been caused in some way by the conduct of the applicant, and before its patent can be set aside the Government must, in accordance with the rules laid down in respect to said patents, establish that fact clearly. It may not rest on mere inferences, mere suggestions, but must prove the wrong in such a manner as to satisfy the judgment before it can destroy that which its own agents have created. We reiterate what was said by Mr. Justice Miller, for the court, in the Maxwell land grant case, that a suit between individuals to set aside an instrument for fraud can only be sustained when the testimony in respect to the fraud is clear, unequivocal and convincing, and cannot be done upon a bare preponderance of evidence, which leaves the issue in doubt; and that if this be the settled rule in respect to suits between individuals, it is much more so when the Government attempts to set aside its solemn patent. And we may here again repeat that if this is true when the suit is to set aside a patent for land, which conveys for all time the title, a fortiori, it must be true when the suit is one to set aside a patent for an invention which only grants a temporary right.

What evidence has the Government produced? We premise by saying that there is not a scintilla of testimony as to any corruption of the officers of the department by the defendants, or any attempt at such corruption. Counsel do not put the finger on a single fact tending to show that any money was ever paid to any official of the Patent Office, or that any undue influence was ever attempted to be exerted upon or improper suggestion made to anyone. So far as the record discloses, there never was an intimation made to a single official that he could profit in any way by a moment's delay. All thought of wrong in this respect may, therefore, be put aside. If there was no corruption on the part of the defendants, what did they do that calls for condemnation? And we turn to the brief of the learned counsel for the Government to see what evidences of wrong they have found in the record. After noting that their inquiry begins at June 9, 1882, thus impliedly conceding that there is no reason to question the delay up to that time (a period of five years), they call attention to the subsequent correspondence between the solicitor in charge of the application and the officials of the department, which, so far as is material, is as follows:

"On June 9, 1882, the examiner wrote to the solicitor as follows: 'As at present advised it is believed that the claims presented may be allowed, but final action in this case must be suspended in view of probable interferences with other pending applications, which will be declared as soon as practicable.'

"On October 8, 1883, sixteen months later, the solicitor wrote as follows: 'In June, 1882, I received an official letter, dated the 9th of that month, saying that 'the claims presented may be allowed, but final action is suspended in view of probable interferences.'' Since then I have been awaiting the official action. I beg to call attention to the case and ask that it may receive action.'

"October 23, 1883, the examiner, as follows: 'In response to applicant's letter filed October 9, 1883, it is stated that further action in this case on the part of the office must be still further postponed until the conditions of interfering applications will permit the declaration of interference, which seems unavoidable.'

"On February 19, 1886, two years and four months later, the solicitor, as follows: 'The specification is hereby amended as follows: Erase amendment O, filed December 16, 1881. Erase claims 3, 7, 8, 10 and 11, and change number of claims 4, 5, 6, 7 and 9 to 3, 4, 5, 6 and 7.'

"This amendment contained nothing material to the present discussion.

"March 17, 1886, the examiner, as follows: 'In response to amendment of February 19, 1886, applicant is advised that the broad claims involving the idea of a variable pressure contact telephone will probably be involved in an interference with a pending application or applications of another applicant, and that said applicant has been advised that he must show that the office action taken in the matter of his application is not a sufficient answer thereto on or before the 1st of April, 1886. In the meanwhile this application will be suspended from further action.'

"August 13, 1886, five months later, the solicitor: 'I desire to be informed of the present status of this case, and to be advised if the office is awaiting any action on the part of the applicant. It is desired that no rights should be lost by inaction.'

"August 19, 1886, the examiner, as follows: 'In response to applicant's letter of the 13th inst. he is hereby advised that the delay in this case is a matter over which he has no control, except it be, perhaps, in the matter of urging an early interference. The interference will be declared as soon as the other applicants are in condition, if it be decided that they are entitled to the same. The office is awaiting no action on the part of the applicant, and the delay is through no fault of his.'"

After these quotations, counsel observe as follows:

"These perfunctory exchanges of compliments between the solicitor and the examiner occupied the entire time from June 9, 1882, to March 16, 1888, five years, nine months and seven days. In all that time not a demand for action, not a hint even of dissatisfaction, appears in the record. We have quoted it all. Of course, this appearance of willing acquiescence is not conclusive. The examiner's letters indicate an obstacle in the way; some portending interference or interferences, always coming, yet never arriving. But the supine submission of the company to such extraordinary delay, for such a cause, is the first item of the proof. If it had been possessed of a real purpose to have its patent as soon as possible, if it had been losing millions per annum for want of it, as the people are losing millions because of it, would it not have found some way to force this invisible foe into the field, or at least leave on the record some trace of its mighty effort to burst the bands of official routine which prevented it from finding and fighting him?"

This presents the burden of the case on the part of the Government. It amounts to only this: The defendant company was not active but passive. If millions were to be added to its profit by active effort it would have been importunate and have secured this patent long before it did. As millions came to it by reason of its being passive, it ought to suffer for its omission to be importunate. It must keep coming before the commissioner like the widow before the unjust judge in the parable, until it compels the declaration, "though I fear not God nor regard man, yet, because this widow troubleth me, I will avenge her, lest by her continual coming she weary me." But is this the rule to measure the conduct of those who apply for official action? What is the amount of the importunity which will afford protection to the grant finally obtained? How frequent must the demand be? It is easy to say that the applications of this defendant, coming only at the interval of months and years, were, taken with the replies of the Patent Office, mere "perfunctory exchings s of compliments," but this does not change the fact that action was asked and repeatedly asked; that no request was made for delay, no intimation that it was desired or would be acceptable.

In this connection may well be noticed the letter of the solicitor, in March, 1881, to the commissioner, in which he urged the modification of Rule No. 94 in respect to interferences, and this in order to hasten the issue of the patent. In this letter, besides pointing out how the rule as it then existed would tend to delay, he adds these statements:

"So far as my client is concerned, I have to submit that it is of the utmost importance that the interference he declared forthwith. * * *

"The indefinite suspension of the interference would only create harassing and oppressive claims after the public had become possessed of the invention without hinderance or objection on the part of the inventor, and it is but just to say that neither of the interfering applicants could with any degree of propriety claim to be the inventor and expect that such notice on his part would be treated by the public with any degree of respect. Patents issued as the result of long pending interferences are always looked upon as odious monopolies because of the manner in which they are enforced at the time when the public were already possessed of the invention. * * *

"* * * An early decision upon the question submitted is earnestly requested."

It may be added that the modification was made in October, 1881.

In respect to this letter, and especially the second paragraph, quoted above, counsel for the Government say:

"In the argument below, counsel appeared to think that once was enough, and that they stood as a perpetual exhortation to duty to the examiner and all his successors as though they had been nailed on his office door. But they were not even in the file of the Berliner case. Examiner Freeman, whose report was indorsed on the letter, went out of office in 1883. If any one ever saw it after that until it was examined for the purpose of this case, the fact does not appear in the record."

But is the applicant to be condemned because, having once made an urgent request for action and pointed out reasons therefor, it was not continually repeating that request, because it did not see that such request was placed on the files of this particular application, or, as intimated in the words of counsel, nailed on the doors of the Patent Office?

It is, of course, easy to say that these applications, these suggestions and requests meant nothing; that they were a mere blind; but something more than assertion of counsel is necessary to destroy their significance, or to establish collusion between the applicant and the officials of the department. But the case does not stand upon the fact that the formal communications from the solicitor in charge of this application were few in number. While in every one, in which the matter was referred to, there was a request for action, it also appears from the testimony of Messrs. Freeman, Lyons and Kintner, who were the examiners in charge during the major portion of the time in dispute, that the representatives of the Bell company were urgent in pushing the Berliner application. For instance, Examiner Lyons testified:

"They were urgent and persistent beyond toleration. Hardly a day passed without somebody representing the interests of the Bell Telephone company coming to our room and urging the allowance of the Berliner case, or the declaration of interferences. I myself was waylaid in the halls of the Patent Office, and on more than one occasion did I sneak into the room to avoid being bored by Mr. Charlie Hedrick, the assistant of Mr. Pollok. Mr. Pollok himself, also, although less frequently, came to the room, and, later on, notably toward the end of 1884, and in the spring and summer of 1885, Mr. W. W. Swan was a frequent visitor in the electrical division."

Asst. Examiner Kintner, (who was in office from May, 1883, to April, 1887), in reply to a question as to what Mr. Swan, one of the representatives of the telephone company, did in respect to the application, said:

"I had a great many interviews with him in the matter of both the Edison and the Berliner applications under consideration, and he was very persistent in urging the passage of both applications to patent; in fact, to such an extent that his persistency annoyed me not a little."

Another matter referred to by counsel is what they call the "tacit understanding." The facts are these: One Daniel Drawbaugh claimed to have invented the telephone prior to Bell. He assigned his inventions to the People's Telephone company, between whom and the defendant company a heated and protracted litigation arose. Now, it is said that there was an agreement, or, at least, a tacit understanding, between the officials of the Patent Office, the People's company and the defendant company that the proceedings in the Patent Office in respect to the Berliner application should wait the determination of the litigation between the two telephone companies. It is insisted that the officials had no right to enter into such an agreement; that it was unlawful in its character. Assuming that this is so, still the fact appears that the proposition therefor came from the representatives of the Drawbaugh interest, that it was deemed by the officers of the Patent Office to be for the best interests of all, and that it was

simply assented to by the defendant. Nowhere does it appear that the defendant urged, or even suggested, the propriety of such a delay. For the present we do not consider the wisdom or the rightfulness of the course pursued. All that we desire to notice is that it was not at the instance of the defendant.

It is further said that, even if there were at first any excuse for such "tacit understanding," and the Patent Office properly delayed action on this application until after the litigation between Drawbaugh and Bell had ended, a judgment therein was rendered in the Circuit Court in 1884; and that then the office should have proceeded promptly, and that there was no excuse for waiting until the decision of the appeal by this court in 1888; and least of all for any delay after that final decision by this court.

Summing up their argument on this branch of the case, counsel say:

"The review of the history of the Berliner application which we have now completed shows that in its treatment of it the office proceeded upon two unlawful assumptions.

"The first was that an applicant, whose application is ready for issue except for a possible threatened interference, must wait until the antagonizing application is either found allowable and ready for the interference, or finally ejected from the office, no matter how long that may be. This assumption governed the action of the examiners from 1882 to the issue of the patent. * * *

"The second assumption was that the judicial determination of the question of Drawbaugh's invention, in the suit between the owners of the applications, was not enough to warrant action by the office. Examiner Kintner took the ground, in conversation with Mr. Swan—never on the record—that the decision of the Circuit Court was not enough for him; that the case might be appealed, and he would act only on the decision of the Supreme Court. But when that came, it received no more consideration than had been given to that of the Circuit Court."

Were it conceded that these two assumptions were "false assumptions," as counsel call them, what are they but errors of judgment on the part of the patent officials as to the course of procedure; and can it be possible that an applicant for a right, who has under the statute no choice of tribunals or course of procedure, but is compelled to apply to one tribunal which has exclusive jurisdiction in the matter, and must abide by its rulings as to procedure, can be held to have forfeited his right simply because of errors of judgment by such tribunal as to the procedure? The statement of the question seems to us to carry its own answer. It is true counsel follow this declaration of the errors on the part of the office in the matter of procedure with the further statement:

"The guilty party is the Bell company. It had a full and perfect inside view of the whole situation from the beginning. Its attorneys were wiser in these things than the commissioners or the examiners. They shrewdly availed themselves of every unauthorized usage, mistaken assumption, ignorant misconception, or supposed obstacle, by means of which the issue of the patent could be delayed without apparent responsibility on their part. In view of the duty which vested upon the company to speed the application, that was fraud, not less but more reprehensible because it was not of the common and gross kind, but so refined and acute that its garb of professed innocence has deceived even the Court of Appeals."

The difficulty with this charge of wrong is that it is not proved. It assumes the existence of a knowledge which no one had; of an intention which is not shown. It treats every written communication from the solicitor in charge of the application, calling for action, as a pretense, and all the oral and urgent appeals for promptness as in fact mere invitations to delay. It not only rejects the testimony which is given, both oral and written, as false, but asks that it be held to prove just the reverse.

Indeed, the case which the counsel present to us may be summed up in these words: The application for this patent was duly filed. The Patent Office, after the filing, had full jurisdiction over the procedure; the applicant had no control over its action. We have been unable to offer a syllable of testimony tending to show that the applicant ever in any way corrupted or attempted to corrupt any of the officials of the department. We have been unable to show that any delay or postponement was made at the instance or on the suggestion of the applicant. Every communication that it made during those years carried with it a request for action, yet because the delay has resulted in enlarged profits to the applicant, and the fact that it would so result ought to have been known to it, it must be assumed that in some way it did cause the delay, and having so caused the delay ought to suffer therefor. There is seldom presented a case in which there is such an absolute and total failure of proof of wrong.

The defendant company might safely have left the case here, but it has not been content to rest the controversy with the failure on the part of the Government to show any wrong. It has not been content to accept the Scotch verdict of "not proven." It has called as witnesses the examiners who were in charge of this application, and taken their testimony as to what did in fact take place, and as to how and why the long delay occurred. Whatever judgment may be pronounced upon the wisdom of the course pursued by these officials, or the sufficiency of the reasons given by them therefor, there is no ground for controverting that they acted in good faith. The case is not one of arbitrary, peremptory postponements and delay.

They supposed they were acting in compliance with the rules of the Patent Office, and out of proper regard for the rights of conflicting interests. No just estimate can be placed upon the propriety of their conduct without taking into consideration the whole subject of telephonic inventions and litigation. As heretofore stated, and as is well known, Bell claimed to be the pioneer in this matter of telephonic communication. His claim was disputed, and out of that dispute came the most important, the most protracted litigation which has arisen under the patent system in this country. For years this litigation was pending in the trial courts, subsequently brought to this court, and finally decided in 1888. So great was this litigation, so immense the volume of testimony, and so important the rights involved, that it is the only case in the history of this court to which an entire volume of our reports is devoted. (126 U. S.) The argument was protracted through weeks, and the case was held under consideration for a year, and finally decided by a closely divided court. Is it strange that, when the primary right was being so vigorously contested, and was so much a matter of doubt, when (as appears from the testimony in this case) the judgment of the law department of the Government was adverse to the claims of Bell, and to the validity of the patent which he had obtained—is it strange, we ask, in view of these facts that the disposition of the apparently minor matter should be held in abeyance in the Patent Office until a final decision of the primary right?

Neither can any just estimate be placed upon their conduct without taking into account the volume of business, and the pressure on account thereof, in the Patent Office. Beyond the fact, which is a matter of common knowledge, that thousands of applications are filed and thousands of patents granted each year, the record discloses something as to the multitude of applications for patents for telephones and telephonic devices which were pending during these years. Mr. Townsend, who was an examiner up to November 15, 1880, while unable to state the number of applications, was able to say that he had examined over 120 that went to patent. This, it will be remembered, was in the early days of telephonic investigation and invention. It appears also from a communication made by the commissioner of patents to the secretary of the interior, on December 13, 1892, advising against this suit, that at that time a gentleman, who is called in the letter the "relator," had pending in the Patent Office 152 applications for patents on telephones and telephone systems. These facts may be only side lights, but they show that the examiners and other officials in the Patent Office had something else to do besides considering this application.

Of course, it is easy to say that the Patent Office could have disposed of this application more promptly than it did; that it ought to have done so, and that, in view of the termination of the great litigation favorable to the claims of Bell, its delay has resulted in large pecuniary benefits to the defendant. But a wisdom born after the event is the cheapest of all wisdom. Anybody could have discovered America after 1492. The question is not whether a better judgment on the part of the patent officials would have disposed of this application long before it was, is not indeed whether there was any error of judgment, but whether they acted wrongfully and their action was induced by or at the instance of the defendant.

One thing more deserves notice. The argument of the counsel for the Government proceeds all along on the assumption of the superior knowledge of the representatives of the defendant company; that they saw the end from the beginning; that they knew that their client had an invention which was patentable and that they would ultimately obtain a patent therefor, and also that Bell was and would finally be adjudged the primary inventor of the telephone; and that possessed of all this knowledge they planned the delay in securing the Berliner patent in order that thereby they might extend to the termination of its life the telephone monopoly. But what an assumption this is and how ill justified by the facts! The very process and termination of the Bell-Drawbaugh litigation demonstrates the doubtfulness of the question there in issue, and is absolute evidence that there was up to the close of that litigation an uncertainty as to the result. Equally uncertain was the outcome of the Berliner application. Indeed, there is an uncertainty as to every application. No one can foretell what will be the judgment of the Patent Office upon the questions of novelty and utility. And in respect to this Berliner application the matters which are subsequently to be considered attest that there was more than ordinary doubt as to the outcome. On account of those matters it is earnestly contended that there was no merit in the application, and that it ought to have been denied. Further than that, they knew that the officials of the Patent Office were subject to change—as in fact they were changed during the pendency of these proceedings—and even if they had any direct intimations from the first examiner or the first commissioner, there was no certainty that a subsequent examiner and subsequent commissioner would entertain the same views. If the Bell-Drawbaugh litigation had terminated the other way (and a different opinion on the part of a single member of this court would have changed this result), or if when the time came the commissioner of the Patent Office had decided against the Berliner application, and his decision been sustained on appeal to the Supreme Court of the District of Columbia, then all this brilliant scheme of realizing millions would have vanished into thin air. If they were possessed of the wisdom which the Government attributes to them, the representatives of the Bell company must have realized that the certainty which attends a final decision and the issue of a patent was something worth striving for, and not lightly to be ignored. And if this underlying assumption has so little foundation, what shall be said of an inference and an imputation unsupported by evidence and based upon that assumption?

Our conclusions on this branch of the case are: First, that before the Government is entitled to a decree canceling a patent for an invention on the ground that it had been fraudulently and wrongfully obtained, it must, as in the case of a like suit to set aside a patent for land, establish the fraud and the wrong by testimony which is clear, convincing and satisfactory. Second, that Congress has established a department with officials selected by the Government, to whom all applications for patents must be made; has prescribed the terms and conditions of such applications, and entrusted the entire management of affairs of the department to those officials; that when an applicant for a patent complies with the terms and conditions prescribed and files his application with the officers of the department he must abide their action, and cannot be held to suffer or lose rights by reason of any delay on the part of those officials, whether reasonable or unreasonable, unless such delay has been brought about through his corruption of the officials, or through his inducement, or at his instance. Proof that they were in fault, that they acted unwisely, unreasonably, and even that they were culpably dilatory, casts no blame on him and abridges none of his rights. Third, the evidence in this case does not in the least degree tend to show any corruption by the applicant of any of the officials of the department, or any undue or improper influence exerted or attempted to be exerted by it upon them, and on the other hand does affirmatively show that it urged promptness on the part of the officials of the department, and that the delay was the result of the actions of those officials. And, fourth, if the circumstances do not make it clear that this delay on the part of the officials was wholly justified they do show that it was not wholly unwarranted, and that there were reasons for the action of such officials, which at least deserve consideration and cannot be condemned as trivial.

The three remaining grounds of relief asserted by the Government may be considered together. Defendant's contend that as the last two, although urged in the Circuit Court, were not presented to the Court of Appeals (referring for this fact to the opinion of the latter court and also a notice which was contained in the brief of counsel for the Government), we are precluded from noticing them, citing as authority Bell vs. Bruen (1 How. 169), Alviso vs. United States (8 Wall. 337), National Bank vs. Commonwealth (9 Wall. 353), Rogers vs. Ritter (12 Wall 317), Klein vs. Russell (19 Wall. 433), Supervisors vs. Lackawanna Co. (93 U. S. 619), Wilson vs. McNamee (102 U. S. 572), Wood vs. Weimar (104 U. S. 786), Topliff vs. Topliff (145 U. S. 156), McGahan vs. Bank of Rondout (156 U. S. 218), and Carr vs. Fife (156 U. S. 494), in which cases, with more or less particularity, the proposition is announced that this court will not consider questions not presented to and passed upon by the lower court. We deem it unnecessary to determine how far that rule is applicable in this case, for the reasons which compel us to deny relief on the first of these grounds are, when applied to the facts developed by the testimony, equally potent as to the others. That ground, as stated, is "that a patent issued November 2, 1880, upon a division of the original application covers the same invention as that covered by the patent in suit and exhausted the power of the commissioner as to that invention." The patent of 1880 is for a receiver; that of 1891 for a transmitter. It is claimed that the two instruments are alike in form and alike in function, save as they are operated at different ends of the telephone wire. The transmitter can be placed at the other end of the wire and then becomes a receiver, and so vice versa. Popularly speaking, it may be said that the transmitter takes the varying sounds of the human voice and passes them on to the telephone wire, to be borne along thereon by the undulatory electric current until they reach the receiver, which takes and passes them to the human ear. In a sense the receiver is also a transmitter, for it passes the sounds from the wire to the ear. We agree with the Court of Appeals that it is unnecessary to determine whether there are two separate inventions in the transmitter and the receiver, or whether the patent of 1891 is for an invention which was covered by the patent of 1880. The judgment of the Patent Office, the tribunal established by Congress to determine such questions, was adverse to the contention of the Government, and such judgment cannot be reviewed in this suit.

Suits may be maintained by the Government in its own courts to set aside one of its patents not only when it has a proprietary and pecuniary interest in the result, but also when it is necessary in order to enable it to discharge its obligations to the public, and sometimes when the purpose and effect are simply to enforce the rights of an individual. In the former cases it has all the privileges and rights of a sovereign. The statutes of limitation do not run against it. The laches of its own officials does not debar its right. (Van Brocklin vs. Tennessee, 117 U. S. 151; United States vs. Nashville Railway Company, 118 U. S. 120; United States vs. Insley, 130 U. S. 263.) But when it has no proprietary or pecuniary result in the setting aside of the patent; is not seeking to discharge its obligations to the public; when it has brought the suit simply to help an individual; making itself, as it were, the instrument by which the right of that individual against the patentee can be established, then it becomes subject to the rules governing like suits between private litigants. As said in United States vs. Beebe (127 U. S. 338, 347):

"We are of the opinion that when the Government is a mere formal complainant in a suit, not for the purpose of asserting any public right or protecting any public interest, title or property, but merely to form a conduit through which one private person can conduct litigation against another private person, a court of equity will not be restrained from administering the equities existing between the real parties by any exemption of the Government designed for the protection of the rights of the United States alone. The mere use of its name in a suit for the benefit of a private suitor cannot extend its immunity as a sovereign government to said private suitor, whereby he can avoid and escape the scrutiny of a court of equity into the matters pleaded against him by the other party; nor stop the court from examining into and deciding the case according to the principles governing courts of equity in like cases between private litigants." See also United States vs. Des Moines etc. Co. (142 U. S. 510), Curtner vs. United States (149 U. S. 662).

Now, in the case at bar the United States has no proprietary or pecuniary interest. The result, if favorable to it, would put no money in its treasury or property in its possession. It has a standing in court either in the discharge of its obligation to protect the public against a monopoly it has wrongfully created, or simply because it owes a duty to other patentees to secure to them the full enjoyment of the rights which it has conferred by its patents to them. Perhaps both of these objects were in view. In so far as the latter was and is the purpose of this suit it brings it within the rule laid down in United States vs. Beebe, supra. Doubtless the removal from the public of the burden of a monopoly charged to have been wrongfully created was also one of the objects, and perhaps the principal object. (United States vs. American Bell Telephone Co., 159 U. S. 548.) To what extent this may relieve the Government as suitor from all the rules governing the suits of private individuals need not be specifically determined here.

One of the familiar rules of equity, reinforced by statute (sec. 723, Rev. Stat.) is that "suits in equity shall not be sustained in either of the courts of the United States in any case where a plain, adequate, and complete remedy may be had at law." The objection to the validity of this patent on the ground that it was already covered by the patent of 1880 is a defense which, under the statutes (sec. 4920, Rev. Stat.), is open to every individual charged by the patentee with infringement, whether the proceeding against him be an action at law or a suit in equity. The Government, therefore, if seeking simply to protect the right of an individual, ought not to be permitted to maintain a suit in equity to cancel that against which the individual has a perfect legal defense available in any action brought by or against him. The query is pressed whether the same rule would not also apply when the Government is only seeking to protect the public at large, for the public is but the aggregation of all the individuals, and if each of them has a perfect defense to the patent, so all together have. Again, and as an illustration perhaps of the extent of the rule referred to, it has often been held that while one having the title to and possession of a tract of land can maintain a suit in equity to cancel a deed or other instrument which is a cloud upon the title, such suit cannot be sustained if the deed or instrument is void upon its face, its invalidity resting upon matters of record, and not affected by any lapse of time or statute of limitations. In other words, the deed or instrument is not considered a cloud if it can never be used to destroy his title or disturb his possession. The objection to this patent on the ground stated is an objection resting upon matters of record—of record in the Patent Office; not dependent on oral testimony nor subject to change, and in no way affected by lapse of time. Within the scope of this specific application of the general rule it would seem that equity has no jurisdiction either at the suit of the Government or of an individual to formally cancel that which by record and unfailing evidence is, as claimed, absolutely void.

But, further, Congress has established the Patent Office, and thereby created a tribunal to pass upon all questions of novelty and utility. It has given to that office exclusive jurisdiction in the first instance, and has specifically provided under what circumstances its decisions may be reviewed, either collaterally or by appeal. As said in Butterworth vs. Hoe (112 U. S. 50, 67): "That it was intended that the commissioner of patents, in issuing or withholding patents, in reissues, interferences and extensions, should exercise quasi-judicial functions, is apparent from the nature of the examinations and decisions he is required to make, and the modes provided by law, according to which, exclusively, they may be reviewed."

Sections 4911 to 4914, Rev. Stat., grant appeals in certain cases to the Supreme Court of the District of Columbia. It is true those sections do not authorize appeals on behalf of the Government, but the failure so to do may be evidence that Congress thought the Government ought not to interfere; and because it believed it had made ample provision for securing the rights of all without the intervention of the Government. Section 4915, Rev. Stat., authorizes a suit in equity on behalf of an applicant for a patent whose application has been refused. Morgan vs. Daniels (153 U. S. 120) presented a controversy under that section, and in the opinion, on page 124, we said: "It is a controversy between two individuals over a question of fact which has once been settled by a special tribunal, entrusted with full power in the premises. As such it might be well argued, were it not for the terms of this statute, that the decision

of the Patent Office was a finality upon every matter of fact."

It is true that all these sections refer to proceedings between individuals, but the Government is as much bound by the laws of Congress as an individual, and when Congress has created a tribunal to which it has given exclusive determination in the first instance of certain questions of fact and has specifically provided under what circumstances that determination may be reviewed by the courts, the argument is a forcible one that such determination should be held conclusive upon the Government, subject to the same limitations as apply in suits between individuals.

"There is nothing in United States vs. Bell Telephone company (128 U. S. 315), and United States vs. American Bell Telephone company (159 U. S. 548), to conflict with the views above expressed. In the former case the question presented was whether the Government could maintain a bill to set aside a patent for an invention on the ground of fraud in its issue, and among the objections urged was the fact that Congress had, in section 4920, Revised Statutes, made specific provision for certain defenses in suits by an infringer. It was held that the Government could maintain such a bill, and that these special statutory provisions did not defeat its right, the court summing up the discussion in these words (p. 373):

"The argument need not be further extended. There is nothing in these provisions expressing an intention of limiting the power of the Government of the United States to get rid of a patent obtained from it by fraud and deceit. And although the legislature may have given to private individuals a more limited form of relief, by way of defense to an action by the patentee, we think the argument that this was intended to supersede the affirmative relief to which the United States is entitled, to obtain a cancellation or vacation of an instrument obtained from it by fraud, an instrument which affects the whole public whose protection from such a fraud is eminently the duty of the United States, is not sound."

In the latter case, which is the one now before us, there was decided a motion to dismiss for want of jurisdiction in this court of an appeal from the decision of the Court of Appeals, and it was adjudged that this court had jurisdiction. It is true, at the close of the opinion is found this general statement as to the power to maintain such a suit (p. 555):

"In United States vs. Telephone company (supra), it was decided that where a patent for a grant of any kind issued by the United States has been obtained by fraud, by mistake or by accident, a suit by the United States against the patentee is the proper remedy for relief, and that in this country, where there is no kingly prerogative, but where patents for land and inventions are issued by the authority of the Government, and by officers appointed for that purpose, who may have been imposed upon by fraud or deceit, or may have erred as to their power, or made mistakes in the instrument itself, the appropriate remedy is by proceedings by the United States against the patentee."

But while there was thus rightfully affirmed the power of the Government to proceed by suit in equity against one who had wrongfully obtained a patent for land or for an invention, there was no attempt to define the character of the fraud, or deceit, or mistake, or the extent of the error as to power which must be established before a decree could be entered canceling the patent. It was not affirmed that proof of any fraud, or deceit, or the existence of any error on the part of the officers as to the extent of their power, or that any mistake in the instrument was sufficient to justify a decree of cancellation. Least of all was it intended to be affirmed that the courts of the United States, sitting as courts of equity, could entertain jurisdiction of a suit by the United States to set aside a patent for an invention on the mere ground of error of judgment on the part of the patent officials. That would be an attempt on the part of the courts in collateral attack to exercise an appellate jurisdiction over the decisions of the Patent Office, although no appellate jurisdiction has been by the statutes conferred. We are of opinion, therefore, that the question, as stated, is not open for consideration in this case. We see no error in the decision of the Court of Appeals, and its decree, dismissing the bill, is affirmed.

Mr. Justice Harlan dissented.

Mr. Justice Gray and Mr. Justice Brown were not present at the argument, and took no part in the decision.

Independent Telephone Companies Organizing.

In a dispatch to the *Chicago Record* from Fort Wayne, Ind., dated May 24th, this information is given: "An important meeting of independent telephone managers was held here to-day and a committee appointed to organize a meeting of all independent companies in the United States to combine in opposition to the Bell company. Judge R. S. Taylor, counsel for the United States, was retained as permanent counsel and made a long report to the members of the meeting. He declared the suit had beeo of great benefit to the independent companies, giving them opportunity to enter the field and keeping the Bell company at bay for four years. The next meeting will be held in Pittsburg in 30 days to take further steps to making a national organization. A committee of five will meet in Detroit next Saturday to perfect the plans for the fight against the Bell company."

Telephone News from the Northwest.

[From the Minneapolis correspoodeot of the WESTERN ELECTRICIAN.]

Allen Tompkins has been granted a franchise at Minot, N. D., for a telephone system.

Work is being pushed on the telephone system of A T. Presson, at Hudson, Wis., and connection will be made with New Richmond and other points.

The Wayne County Telephone company will be requested to build a telephone line between Allerton and Humeston, Iowa.

John Williams and Ole Burnstad were granted a telephone franchise at Willmar, Minn.

The special committee of the Minneapolis Council recommends granting a franchise to the Western Telephone Construction company of Chicago and to the Mississippi Valley Telephone company of Keokuk, Iowa.

Geo H. Stanton has applied for a franchise for a local telephone exchange at Great Falls, Mont.

Sioux City, Iowa, has telephone connection with Sioux Falls, S. D , over the lines of the Iowa Telephone company.

The American Telephone & Telegraph company has resumed work on its lines west from Davenport, Iowa.

R. W. Stewart, who was granted a telephone franchise at Dubuque, Iowa, and has until May 25th to accept it, has asked for further time, in which to look up the recent Supreme Court decision on the Berliner patent.

The New Ulm Telephone company of New Ulm, Minn., has been incorporated with $10,000 capital stock.

Litigation Based Upon the Berliner Patent.

In view of the recent developments in the telephone situation it will be of interest to recall the fact that there is now pending a case in which the validity of the Berliner patent is involved. On August 5, 1895, a bill was filed in the United States Circuit Court at Boston by the American Bell Telephone company against the National Telephone Manufacturing company for the infringement of the Berliner patent No. 463,569. The defendant's answer was filed by Edward P. Payson in October, 1895, and the plaintiff's *prima facie* case was completed two months later. The introduction of documentary evidence was begun on October 28, 1896, but was interrupted when the arguments were made in the Supreme Court of the United States in the government suit for the annulment of the patent, and it may be resumed at an early day. As soon as the record is complete, as far as documentary proofs are concerned, experts will be called for the defense. The points upon which testimony will be taken include the Bell patent, Edison's priority, expired foreign patents, the insufficiency of Berliner's application, the true significance of his caveats, the identical nature so far as telephony is concerned of variation of pressure and of area and the limited scope of the Berliner patent even if valid. The National company hopes with the information in its possession to demonstrate that the Berliner patent does not cover an invention that is an essential feature of commercial telephony as practiced to-day.

Governmental Ownership in Brazil Unsatisfactory.

The government of Brazil has become tired of operating railways, and by an act of the last congress offered to lease the entire system of 14,000 miles of track belonging to the government to any responsible authority who would pay a bonus of £14,000,000 or more. No bids have been received, although propositions have been made by two syndicates for certain parts of the system that are regarded as desirable. William E. Curtis, the Washington correspondent of the *Chicago Record*, explains the condition of affairs in a manner that will be very interesting to those who are considering the advisability of the government engaging in enterprises of this kind. "The object of unloading the railroad system," he says, "is to relieve the taxpayers of a large annual deficit. Government operation of railways, which is advocated by many people in this country, has not proved successful in Brazil, the chief reason being the difficulty of keeping politics out of the management. The Central road, for example, which used to pay nine per cent. dividends, is now a burden upon the government to the extent of two or three millions a year, which is entirely due to politics and the employment of incompetent men for political reasons. The same is true of other railways, and, although they have been very important in the development of the resources of the country, it is believed by the wisest men that they would serve this purpose equally well under private management. In addition to the government system of 14,000 miles, there is about 4,000 miles under private management, most of which is subsidized. Several of these roads are paying good dividends; others, which have a six per cent. guaranty, do not call upon the government for more than two or three per cent."

Municipal Ownership an Evil.

[From the *Chicago Chronicle.*]

A judge in New York city has decided that the municipality is debarred from purchasing a certain street railway line. The decision has caused great grief among those people who are always urging the municipal ownership of street car lines, gas plants and other public works, but the city may be congratulated that it has been debarred from that questionable privilege. There is too much paternalism in this country as it now is, and of all things to be avoided is the city ownership of street railway lines. New York disposes of its franchises to the highest bidder and then seeks to control in a reasonable degree the management of the lines. Handsome sums are realized, and it would do well to be satisfied with this.

Limitations of Government in Water Power Plants.

By MARK A. REPLOGLE.

The regulation of the speed of a water-wheel in a power plant is determined by four distinct factors:

1. Changes in load or requirements for power.
2. Time required for gravity to generate power.
3. Capacity of the plant for stored energy.
4. The governor or mechanism that should automatically combine the first three factors in such a manner as to obtain even speed or good regulation.

These factors, clearly defined, are bases from which intelligent calculations can be made showing the possible efficiency of government in any water power plant.

Let it be understood that the word "government" refers to that regularity of motion or speed that is so desirable and necessary in our finest manufacturing and electrical power plants. Absolutely uniform speed can be maintained only when there is no change in the power supply and no change in the friction or work of the plant; but if the above factors are carefully considered and judiciously manipulated or applied, the variations of speed may be so reduced that the results can be called perfect government.

The speed of a plant at all times is a resultant of opposing forces establishing an equilibrium or balance. The power supply has a tendency to increase speed and the work has a teodency to decrease it. Speed may be varied by increasing the power supply or by decreasing the power supply; by increasing the amount of work performed, or by decreasing the amount of work performed; and any one of the above changes causes instantly a change in the speed; but the amount of change in speed depends entirely upon the amount of change in load, the time it takes gravity to generate power, the quantity of energy in store, and the operation of the governor in opening or closing gate.

Since it is impossible for any automatic governor to change the power supply at the instant a change has been made in the load or work of a power plant, it is very plain that there must be fluctuations in the speed. The problem of government is to narrow these fluctuations to such an extent that the speed will be constant as far as practical operation is concerned. The finest government ever obtained consisted of changes in speed, but within narrow limits. The speed of a well-governed single-crank engine changes four times every revolution.

The first factor in governing, "the changes in load" is a variable one, and is limited only by the character of the work done by the water wheel. The changes may range from zero to the full power of the wheel instantly, making government a more difficult problem than it would be if the changes were limited in number or quantity. It is plain that if an even speed is retained when a change in load is made, there must be at the same instant a corresponding change in the power supply. This is an impossibility in automatic governing, for several reasons: the speed must change in order to inspire the speed governor, following this, the speed governor causes the valve or gate moving mechanism to operate, which operation requires time; and again, it requires time for gravity to overcome the inertia of the increased quantity of water that must pass through the wheel before an increase in power can be had. During all this time, the speed of plant has been decreasing if the load was increased, or increasing if the load was decreased, and the amount of change in speed depends entirely upon what ratio the change in load bears to the stored energy in the moving parts of the plant. A heavy change in load will of course cause a greater change in speed before the power supply is changed than a light change in load. The problem is, therefore, to proportion properly the power-storage to the changes of load that must be imposed upon the plant, because this power-storage, or the capacity to store power, must take care of all changes in load until the power supply or gravity effects can compensate for said changes.

The second factor, "time required for gravity to generate power," is more constant than the first. In fact, the limits are established in the construction of the water power plant, and, of course, remain so. The point we wish to emphasize most in the time requirements is the inertia and momentum effects of the water.

A locomotive can propel a train of cars at a rapid speed; but it takes time to acquire such speed. When the locomotive has brought enough pressure to bear upon the train, it moves, at first slowly, but keeps increasing in speed often many seconds before it reaches full motion. The locomotive may be limited in strength to 250 horse power per second. The train in full motion may represent 25,000 horse power for a second. In such case, it will take the locomotive 100 seconds to bring the train to speed if we do not consider the frictional losses. Water has no power in itself, but must be put in motion by gravity in the same manner that the locomotive starts the train of cars, and a long train of water acted upon by a constant gravity effect is put in motion in the same manner that the train of cars is by the locomotive. It is plain, then, that the time element must be considered in the government of water power. The water wheel cannot furnish power until it brings to rest the water to which gravity has given motion, and it can receive no power from the water until the water has sufficient motion for the moving wheel to retard. It is also plain that there must be changes in the flow and velocity of water for every change made in the load of the water wheel; also the change in the flow of water must occur before there can be a change in the power supply.

It is well known that water has practically no elasticity, hence, if inclosed in a long pipe, the whole body must be put in motion at the same time. If pipe or flume

consists of several hundred feet of horizontal length and only a few feet of vertical pipe or "head," which alone gives gravity effects on the wheel, it is a similar proposition to the locomotive and train of cars. It is very evident, then, that long horizontal pipes should be avoided in order to reduce to a minimum the time required to get gravity effects, because the speed of water wheels will keep changing, after a change in load, until the effects from gravity can correct it in the power supply.

Gravity effects at best are very slow as compared with steam, and for this reason a water power is handicapped in the matter of government. The logical conclusion is that in water powers the water or power supply should all be under the direct action of gravity and move in line with it. This reduces the time necessary to furnish increased or decreased power to the shortest limit.

Electric Lighting of Underground Galleries in Cement Quarry.

An interesting electrical installation has recently been made in the quarries and mills of the F. O. Norton Cement company at Binnewater, N. Y., situated in the Rosendale cement district, about seven miles from Kingston.

This company manufactures the natural cement as distinguished from the Portland, the bulk of the latter consumed here being imported from Europe. The deposit from which the Norton (natural) cement is made is bluish gray magnesian limestone or cement rock found in strata of between 14 and 17 feet in thickness, constituting the hills along the valley of Roundout Creek.

The power plant consists of four horizontal steel tubular boilers, furnishing steam at 100 pounds pressure to a 750 horse power Harris-Corliss cross-compound slow speed engine. This power is used to operate 16 cracker mills, the crushers, etc. Twenty kilns are now in service.

The electric plant consists of a 30 kilowatt alternating current incandescent dynamo, manufactured by the General Electric company, as are also the lamps and wiring devices of the plant. This machine is driven by a 10 by 12 horizontal automatic Ball engine. There are now installed 103 incandescent lights, in the kilns shed, where the calcined product is taken to the crushers, the mills, the packing rooms, the shipping rooms and other departments of the factory. The quarries are lighted by 40 incandescent lamps and 14 arc lamps. The current is used at a pressure of 300 volts, being reduced by transformers to the necessary voltage for arc and incandescent lamps. Each arc lamp is operated by its individual transformer. In addition one or two incandescent lamps on flexible cords, protected by wire cages, will be operated from the same transformer where particularly close light is required. Arc lamps are also connected by flexible cord to the transformers which are placed back of the nearest pillar to the face of the gallery. The lamps are supported from the roof of the gallery by means of rope and pulley and give a most satisfactory general illumination for the whole work. The men have suspended a light for handling the drills and shoveling the broken stone in the loaded cars, etc. Incandescent lights fixed in position are placed at the main platforms, turn-table, etc., while lamps for the purpose of general illumination are also placed at moderate intervals along the galleries now being operated. When the blasts are fired, the lamps are unhooked and taken back behind the pillars.

The installation has entirely done away with oil lamps, the use of which in many cases rendered work almost impossible, it being necessary to place the drills at the very top of the gallery on a shelf sufficiently below the roof for the erection of the drill. In the days of oil lamps the room was so filled with smoke and fumes that the men could only work there for a short time; in fact the whole mine was rendered murky and disagreeable to work in by the odor from the lamps.

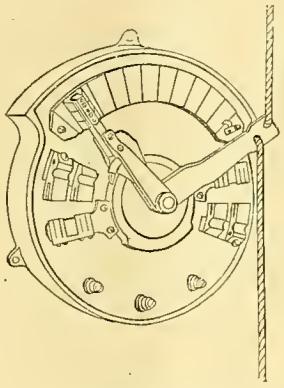
The circuits are carried into the quarries from the power house a distance of about 400 feet in one direction and 1,500 feet in the other. They are carried along the galleries, fastened to insulators fixed to plugs driven into holes in the roof of the worked-out galleries. From various points main loops are carried to the galleries where the work is going on.

The manager and engineer say that no considerable difference can be detected in the amount of coal used since the introduction of electricity, and they are fully satisfied that it costs no more than they were obliged to pay each month for oil under the old method. They are equally certain that the amount of work which can be done by means of electric illumination is greater and far more easily performed. The present electric plant is only working to about one-half its capacity and lights will be added as the work is extended.

New Motor Starter.

The new auto-motor starter recently put upon the market by Thomas Muir & Son of Detroit, Mich., herewith illustrated, has attracted considerable attention among electric elevator builders and construction men.

The main knife switch of this starter is thrown in by the pulling down of the hand-rope, and is held in contact by a magnetic lock. This magnet at same time releases the rheostat arm, which (being controlled by a coil spring and fan mechanism) is moved forward over the segments, thus cutting out resistance. The rheostat arm here contacts with a post which may be wired for pilot lights in the elevator. The motor is shut off by a reverse pull of the hand rope, which carries back the rheostat arm to zero, and in doing so opens the main switch and winds up the coil spring. Any failure of current or short-circuiting of the line allows the magnetic lock to release the main knife switch, and gives absolute protection to both the motor and starter. The



NEW MOTOR STARTER.

rheostat arm must again be pulled back to zero point before the motor can be started; but this movement, being mechanical, and done by the rope, is not only quick, but under control of the operator.

The starter was especially designed for controlling double-belted elevators, but there has arisen a demand for its adaptation to new conditions, and without materially changing its neat and compact appearance, or any of its automatic features. Certain very simple additions are being made which will make it applicable to control electric pumping apparatus, or any description of single-belted elevators. Further information will be promptly furnished by Thomas Muir & Son, Detroit, Mich.

A Plan for a Co-operative Electric Light Company.

Some of the gentlemen interested in the Wood County (Wis.) Telephone company propose that the citizens of Centralia and Grand Rapids organize an electric light company on the mutual plan. As the scheme is rather unusual, although the principle is said to have been applied in the case of the telephone company with great success, the prospectus is given:

We will first prepare articles of incorporation, to be signed by 15 or 20 of the users of electric lights, who shall pay one dollar at the time of signing to cover the expenses of incorporating. The purpose of the corporation will be to furnish light and power. The capital stock will be fixed at $15,000, to be divided into 3,000 shares of $5 each. The board of directors shall consist of five members. The stock shall be sold only to persons who rent lights or power from the company.

We will then open our books for subscriptions—selling one share of stock ($5) for each incandescent light, and 20 shares of stock ($100) for each arc light. The company will reserve the right to purchase at par the stock of any holder who holds more shares than he rents incandescent or arc lights or power.

Holders of electric light stock wishing to dispose of it must first offer the stock to the company before disposing of it elsewhere.

When one-half or more of the capital stock has been subscribed for, we will then open up our books for those who wish to rent lights, and when three-fourths of the present users of electric lights in Grand Rapids and Centralia have agreed to rent from this company, we will then call a meeting of the subscribers to stock and elect a board of directors and submit the question as to whether we should proceed to put in a plant. We would not advise the purchase of a plant unless two-thirds of the subscribers to stock are in favor of it.

As there will be those who will rent, but who will not subscribe for stock, we should provide that a dividend of not less than one per cent. a month, that is, 12 per cent. per annum, should be declared on stock and added to the expense account, also that a sinking fund of one-half of one per cent. should be set apart for future repairs and reconstruction and added to the same account, and that the company should so regulate its rental charges as to make the rental income equal to the cost of maintaining the plant.

A franchise should then be secured from each of the cities, and upon condition that the corporation should at all times be prepared to sell stock to any user of electric light or power in the two cities at par, to an amount equivalent to his rental; that it should furnish light to each of the cities at cost, less the depreciation on account of wear.

Relative Rights of Electric Street Cars and the Public.

The introduction of electricity as a motive power for street cars has, with the increase of speed, increased the friction between the street-car companies and the public as to their relative rights. Touching the latter, the decision handed down by the Supreme Court of Maine, February 24, 1897, in the case of Flewelling against the Lewiston & Auburn Horse Railroad company, is instructive, the spirit it evinces being comparatively liberal. The court says that it apprehends that electric street cars have, in a qualified way at least, the right of way as against persons on foot or traveling with carriages and teams, in the same manner as ordinary steam railroads have. And all persons passing on foot or traveling by the common methods on the highways should carefully observe the movements of the street cars, and leave them an unobstructed passage as well as they reasonably can. On the other hand, it maintains that great care must also be observed by conductors and drivers, or motormen, upon the cars, to see that no injury be caused by themselves to persons or teams. Street railroads, it continues, are granted very great privileges out of the public right, and their treatment of the public must be reasonable in return, so that when a person or a team, through accident or misjudgment, or for any cause, be caught in a position of any peril by coming in collision or close contact with the cars, it is the duty of those who are managing the cars to use all possible effort, by slackening the speed of a car or stopping it altogether, in order to avoid injury. Furthermore, if a horse driven by a traveler appears to be restive or refractory at the sight of a moving car, the movement of the car should be managed in such a way as to relieve, if possible, the traveler in his dilemma For these reasons, as well as for the general safety of passengers within and persons outside of the cars, the rate of speed should be reasonable according to circumstances.

American Institute of Electrical Engineers.

As announced last week, the annual meeting of the Institute was held in New York on May 18th, and it proved to be one of the most successful gatherings in the history of the organization. Before the annual business meeting there was held a meeting of the executive committee, at which the following-named associate members were elected: William C. Banks, New York; Edward C. Clement, Washington, D. C.; A. Davidson, Lima, Peru; Constant de Redon, New York; Sidney Hosmer, Boston, Mass.; Carl Kinsley, St. Louis, Mo.; John Neilson, Larchmont, N. Y.; Albert S. Richey, Muncie, Ind.

The following associate members were transferred to membership: W. W. Nicholson, Syracuse, N. Y.; R. E. Richardson, Chicago; Edward B. Rosa, Middletown, Conn.

At the annual business meeting of the Institute the first order was the counting of the ballots by Mr. Hamilton and Dr. Pupin, who were appointed tellers, and this resulted in the announcement of the election of the council ticket printed last week in this journal. The reports of the council and the treasurer were presented and accepted. The former announced that an executive committee of seven had been appointed to conduct the ordinary affairs of the organization, as under the laws of New York a majority of the council would be required to transact business legally if the old regulations continued, and this was found to be impracticable because of the large number of out-of-town members in that body. It was shown that during the year there had been a net gain in membership of 38, bringing the total membership on April 30th up to 1,073.

The report of the committee on a new design for the Institute badge which had been referred to this meeting by the executive committee was approved, and arrangements for the withdrawal of the old design and substitution of the new one will be made at an early date.

The paper on "The Synchronograph" presented April 21st by Dr. Crehore and Lieut. Squier was taken up for discussion. F. W. Jones opened the discussion, which was participated in by Dr. Kennelly and Mr. Delany. A paper on "The Application of Hyperbolic Analysis to the Discharge of a Condenser" was presented by Dr.

Macfarlane. Owing to lack of time the discussion was pos tponed until the general meeting, July 26th.

At 7 P. M. the meeting adjoorned and 93 members immediately reassembled at the Arena, 41 West Thirty-first street, where arrangements had been made for the annual dinner under the direction of Herbert Laws Webb, chairman of the committee on papers and meetings, and T. C. Martin. Toasts were responded to by Dr. F. B. Crocker, F. W. Jones, Dr. M. I. Pupin, Dr. C. E. Emery, Dr. A. E. Kennelly, Ralph W. Pope, J. W. Lieb, Jr., Herbert Laws Webb, Nelson W. Perry and Joseph Sachs. The exercises were interspersed with instrumental and vocal music by George Heli Guy and Charles McL. Paine. Mr. Guy played a waltz of his own composition which he has dedicated to the American Institute of Electrical Engineers.

Transportation Arrangements for Chicago Members of the National Electric Light Association.

The western delegation to the National Electric Light association's convention is not expected to make as imposing an appearance as usual, owing to the fact that the members will not go in a body. However, it is believed that there will be a large number from Chicago and points west of this city.

The transportation department of the association did not select any special road for the Chicago party, and accordingly the Wabash, Lake Shore and Michigan Central companies are actively engaged in soliciting patronage. All these roads are making arrangements for parties who wish to occupy the same car during the trip, and all are giving the fare-and-a-third rate for the round trip on the certificate plan. The WESTERN ELECTRICIAN will be pleased to furnish additional information to those desiring to attend the Niagara meeting. The schedule and round trip rate on each of these roads is as follows:

	Leave Chicago.	Arrive Niagara Falls.	Fare Round Trip.
Lake Shore	3:00 P. M. 5:30 "	7:00 A. M. 7:00 A. M.	$18.00 20.00
Wabash	3:00 P. M. 11:32 "	8:20 A. M. 5:15 P. M.	$16.00 $16.00
Michigan Central	3:00 P. M. 11:30 "	6:53 A. M. 5:18 P. M.	$18.00 $18.00

Lake Shore Convention Train.

Delegates to the convention of the National Electric Light association may leave Chicago via the Lake Shore & Michigan Southern railway at 3 P. M. or at 5:30 P. M. (New York limited, $2 extra fare) and arrive at Niagara Falls, via Buffalo, the next morning. The compartment car on the limited affords the conveniences and privacy of a stateroom and at the regular berth rates. Those wishing locations in this car should make early application.

Unlimited tickets to Niagara Falls, allowing stop-over at any point between Chicago and Buffalo, inclusive, are only 50 cents higher, and if procured within the conditions of the certificate in no wise affect the one-third limited fare returning.

Applications for berths, etc., may be addressed to the office of the WESTERN ELECTRICIAN or to the city office, 18c Clark street.

Arrangements of the Wabash Road.

The Wabash company, which is making special efforts to accommodate western visitors to the convention, announces that there are two excellent trains over its route, leaving Chicago at 3 P. M. and 11:32 P. M., that will prove particularly well adapted for members. This company's rate-and-a third on the certificate plan for the round trip will be $16. The city office of the company is 97 Adams street.

COMMUNICATION.

English Electrical Journals.

To the Editor of the WESTERN ELECTRICIAN:

My attention has been directed to a paragraph in your issue of the 1st inst. referring to the London *Electrical Review*.

The "puzzling questions" you propound are the very natural outcome of a *suggestio falsi*—intentional or otherwise—by which you have been misled.

In the interval between May, 1864, and May, 1878, there was no *Electrician*. In November, 1872, the *Electrical Review* was started, in the first instance as a monthly paper. In 1878, when the *Electrician* was re-started—I will not say resuscitated—the former paper was a fortnightly one.

It would not be strictly correct to say that the new issue of the *Electrician*, under the auspices of the late Sir John (then Mr.) Pender and the late Sir James Anderson, was a continuation of the old paper founded by the late Owen Rowland and myself and edited by me, although my consent to the use of the title was, as a matter of form, applied for and given. Like the present *Electrical Review*, the old *Electrician*, "such as it was and what there was of it," was entirely independent of any financial control or trade influences. Had it been otherwise, perhaps the awkward hiatus of 14 years would not have occurred.

DESMOND G. FITZ-GERALD.

London, May 14, 1897.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 22.—The right of the city to purchase the franchise for the street railways on Sixth and Eighth avenues, which is mixed up with the desire of the Metropolitan company to introduce electric traction by the trolley conduit system and the bitter opposition of the Third Avenue company, is under consideration by the railroad committee of the Board of Aldermen, and the hearing will be resumed next week, according to the official announcement, although there are those who hint that the inquiry will be dropped.

It seems that it is possible for an ambitious young lady to know too much about fire-alarm boxes. Florence Scannell of No. 103 East Ninety-third street, daughter of ex-Captain Scannell of Fire Engine company No. 30, and a niece of ex-Fire Commissioner John Scannell, together with Emily Roach of No. 325 East Ninetieth street, were arraigned before Magistrate Deuel in Harlem Court a short time ago, charged with malicious mischief by Foreman Conaghan of Engine company No. 53. About eight o'clock at night Edward Nelson and the two prisoners were walking on Park avenue, near Ninety-third street, when Miss Roach expressed a desire to understand the mechanism of a fire-alarm box. To display her superior knowledge, Miss Scannell opened the box and pulled the hook, and in a few minutes Engine No. 53 and several other fire companies responded to the call. Foreman Conaghan called upon Policeman Sweeny of the East 104th street station to arrest the girls, who, after spending the night in the station, were discharged with a reprimand.

For some time the Postal Telegraph company has had trouble with its wires in the northern part of the city. One of the company's linemen, W. H. Harrison, caught a man last week who says he is George Abbott, 46 years old, and refuses to say where he lives. Abbott was arraigned in Center Street Court, charged with stealing 14,800 feet of wire from the company's lines. He admitted his guilt, but, inasmuch as the thefts occurred in Westchester county, Magistrate Kudlich held Abbott to await the pleasure of the Westchester county authorities. Abbott has, it is said, on seven different occasions, cut the Postal company's line, and each time has greatly hampered the work of the New York office. Abbott began work on or about April 23d, when he cut out over 2,600 feet on the New York & Glenville line in Bailey avenue, between Kingsbridge and Morningside Park. Harrison was sent out to locate the break and make an investigation. He met a park policeman who said he had seen a man at work on the wire and gave Harrison a description of the man. A few days later another cut was made in Central avenue, between the city limits and Woodlawn cemetery, when 12 feet was taken. The next heard of the thief was when the line was cut between Bronxville and East Chester, when 1,000 feet was taken. Then followed two cuts on the line between Pelham Park and Pelhamville. Then there was a cut of 2,500 feet between New Rochelle and Pelham Manor. A few days later Harrison was testing wires in Larchmont woods and discovered that there was "no battery." Realizing that the wire had been cut he ran toward New Rochelle and found that the new wire, repairing the last 2,500 feet cut, had been removed. He hurried to the railroad station and there caught Abbott with the wire. Abbott admitted his guilt and Harrison brought him to the Postal building at No. 253 Broadway, where a policeman arrested him.

In the case of the Church of St. Monica against the Phillips Electric Motor company, a verdict for $349 for the plaintiff was rendered. The suit was brought because a motor equipment supplied to pump the church organ failed to work. The motor broke down during service. The crank leading to the bellows broke, causing a great noise, and the organ, which was thus stopped, let forth a bellowing note that greatly alarmed the congregation. Meanwhile the long arm of the crank swung about and just missed one of the singers. M. S.

Northwestern Notations.

MINNEAPOLIS, May 22.—Machinery is arriving and tracklaying is being pushed for the new system of the Citizens' Traction company at Oshkosh, Wis. The council has at last revived the old franchises under which the company is operating. Proceedings for its annulment had been begun. W. R. Conklin of St. Louis has arrived and will be the local manager.

William B. Hale & Co. of St. Paul, dealing in electrical supplies, have assigned to Morgan Brooks.

An ordinance is being prepared in Duluth, Minn., providing for licensing electricians.

Waterville, Minn., will vote on May 24th on a $12,000 bond issue for an electric light and waterworks plant.

The Minneapolis Street Railway company has practically agreed to extend its Como avenue line to St. Anthony Park.

The Fort Wayne Electric corporation has been working up a sentiment in Necedah, Wis., and will put in an electric light plant if sufficient subscribers can be secured.

Albert C. Booth of Cedar Rapids, Iowa, has invented an automatic electrical cut-off for transformers which promises well. Negotiations are pending with Chicago firms for its manufacture.

Allen Tompkins has been granted a franchise for electric lighting and a telephone system at Minot, N. D.

The St. Paul Board of Aldermen has passed an ordinance requiring the change of the cable to an electric line.

F. W. Epley of New Richmond, Wis., has applied to the Stillwater, Minn., council for a franchise for electric power. He proposes to utilize the water power of Apple River falls.

The city of Graceville, Minn., voted to put in a municipal electric light plant.

J. A. Rhomberg, president of the Dubuque, Ia., Street Railway company, was found dead in bed this week. He had suffered from disease for several years, but continued to give business his personal attention.

The city attorney of Stillwater, Minn., has decided that the city cannot purchase the street-car line, as has been proposed.

The election on the installation of a municipal electric light plant at Des Moines, Ia., resulted in a vote of three to one for the plant. The proposition of the McCaskey & Holcomb company will be accepted.

C.

PERSONAL.

Angus S. Hibbard of the Chicago Telephone company has been re-elected president of the Apollo Club of Chicago.

M. E. Baird, general manager of the Eddy Electric Manufacturing company of Windsor, Conn., is in Chicago.

W. B. Hughes, secretary of the Central Manufacturing company of Chattanooga, Tenn., was in Chicago last week.

F. W. Ferguson, secretary of the Walker company, and H. McL. Harding of the New York office of the same company, were in Chicago last week.

W. H. Jacob of the Card Electric company, Mansfield, Ohio, was a Chicago visitor last week. Mr. Jacob, who travels extensively in the interest of the Card company, thinks that the business outlook is encouraging.

Frank W. Hawley, who has just returned to New York from an extensive western trip, says that the electrical people of the Pacific coast would be pleased to have the convention of the National Electric Light association held at San Francisco next year.

Henry L. Doherty of Madison was in Chicago last week. During his visit Mr. Doherty received information that the proposition to establish a municipal plant at Houghton, Mich., which was submitted to the people on Monday, May 24th, had been decided in favor of the central station interest, and he was correspondingly happy over the result.

Dr. Louis Bell has written a series of articles on "Recent American Practice in Electric Railways" for the *Railway World* of London, the first appearing in the May issue. This is one of the indications of the great interest in electric traction now observable in Great Britain and of the desire to obtain the benefit of American experience.

L. E. Frorup, general sales agent of Schiff, Jordan & Co., sailed from New York on Saturday for Europe, where he will enjoy a six weeks' trip. He will spend a large share of his time at the company's headquarters at Vienna, after which he will visit London and Paris in the interest of his concern, and return to New York about the middle of July.

At the meeting of the directors of the Central Union Telephone company in Chicago on May 20th the following was adopted: "By the death of Mr. F. G. Beach the Central Union Telephone company has been deprived of the services of a most popular and efficient general manager, and his associates mourn the loss of a personal friend. Although every mark of the respect, esteem and affection in which he was held has already been publicly manifested, it is proper that the permanent records of the company should bear witness to his worth; therefore, be it resolved, that we gratefully recognize his

faithful, unremitting and conscientious labors in behalf of the company from the time of its organization; that we commend his unselfish devotion to its interests; that we cherish the memory of his uniform courtesy and kindness in all official and personal relations, and that we tender to his devoted widow our most respectful sympathy in her great affliction."

Louis C. F. Schaffer, Antwerp, Belgium; E. G. Bernard, Troy, N. Y.; George A. Redman, Rochester, N. Y.; H. B. Cutter, Philadelphia, Pa.; H. B. Jagoe, Tappan, N. Y.; R. T. McDonald, Fort Wayne, Ind.; Ernesto F. De Castro, Nassau, N. P., and R. Xiques, Havana, Cuba, were among the out-of-town visitors at the headquarters of the National Electric Light association in New York last week.

Frank X. Cicott, well known in electrical circles east and west, has resigned his position with the Ansonia Brass & Copper company at New York, and will be at liberty after July 1st. Mr. Cicott expects to go to Europe to carry out a plan he has long had in contemplation—that of organizing a European company to handle American electrical apparatus. Mr. Cicott's experience in the United States and Europe should stand him in good stead in this venture.

Charles A. Schieren of Brooklyn has just had built for him a handsome new yacht for cruising about Great South Bay. The new craft was named Lorlie by Miss Schieren and launched at Greenpoint Harbor, Long Island, last week. She is built primarily for comfort, but is expected to develop considerable speed, and will be raced by C. A. Schiereo, Jr., in the regattas on the south side of the island. Her hull above the water line resembles the crack Herreshoff thirties of last year.

Col. A. D. Shaw, president of the Canadian Niagara Power company, has been elected commander of the New York state department of the Grand Army of the Republic. Col. Shaw was born in Lyme, Jefferson county, New York, December 27, 1841. When the war of the rebellion broke out, Col. Shaw was a student at Belleville, N. Y., in the Union Academy, and was the first volunteer to enlist from the town of Cape Vincent, N. Y., in Company A, 35th New York Volunteers, at Watertown in May, 1861. He took part in the battles of Rappahannock Station, Second Bull Run, Chantilly, South Mountain, Antietam, Fredericksburg and a number of other minor engagements. At the end of two years' service he received an appointment as special agent of the War Department, and until the close of the war was stationed at the headquarters of the provost marshal in Watertown, N. Y., where he had the supervision of raising troops for filling up the army at the front. In this position he proved an efficient and trusted officer, discharging his duties faithfully and well. At the close of the war he entered St. Lawrence University and completed his education. In 1867 he was elected a member of the Assembly from Jefferson county, and in 1868 he was appointed United States consul at Toronto, Ont., which position he held and filled with credit and satisfaction up to 1878, when he was promoted to be United States consul at Manchester, England, where he served until a change of administration in 1886. His consular reports to the State Department on foreign manufactures, the tariff and revenue reform were exceedingly valuable papers. Last year Col. Shaw was elected a delegate-at-large to the national encampment at Louisville, and he now holds a place on the national pension committee of the Grand Army of the Republic from the state of New York. Col. Shaw's election as commander of the state department of the G. A. R. of New York is eminently gratifying to his legion of friends in the electrical fraternity.

ELECTRIC LIGHTING.

Arrangements have been fully completed for the erection of the electric light plant and waterworks at Milan, Tenn. Proposals are to be opened soon for supplying the equipment.

The Brush Electric Light company at Galveston, Texas, will improve its plant at a cost of about $25,000. Contracts have been let for machinery and supplies that will about double the plant.

Negotiations are said to have recently been completed between a Buffalo syndicate and President Munger of the Canandaigua, N. Y., Electric Light & Railroad company, by which the former will assume control of the plant. The syndicate has also secured a controlling interest in the gas plant, obtaining a majority of the stock at par. It is understood that the stock in the electric light company will be increased to allow of the development and extension of the plant. No new company will be formed. By the deal Canandaigua is assured of the investment of $175,000 of outside capital and much needed improvement in electric light and trolley road service.

ELECTRIC RAILWAYS.

Ever since the first intimation that an industrial town was to be built at Despatch, N. Y., there has been more or less conjecture as to what means of transportation would be afforded between Rochester and the new town. It is now intimated that the University Avenue line will be extended, making a short route to Fairport.

The records in the office of the secretary of state at Albany show that the first two railroads incorporated under the new law in the state of New York, which provides that the organization tax need not be paid until the assurance is received from the State Railroad Commission that the roads can be built, were the Buffalo & Depew Railroad company and the Ocean Electric Railway company in Far Rockaway.

The Florence & Cripple Creek (Colo.) Railway company is considering the question of substituting electrically transmitted power for its steam locomotives. S. T. Smith, the president of the company, and J. C. Henry, the engineer, have the matter in charge.

What appears to be a valuable invention, whereby street-car traffic will not be interrupted by the laying of hose across the tracks in case of fire, is the result of the combined efforts of George F. Flannery and John F. Fromm of Rochester, N. Y. This device is in the shape of a bridge formed of two trusses, each 12 feet long. From either end the truss rises to a flat surface five feet in length and five feet and five-eighths inches above the tops of the street car rails. The trusses are so constructed as to be fastened solidly to the rails, and are made of especially rolled steel, being very strong. The weight of the device is less than 400 pounds and it may easily be carried on the trolley wagon, which, in Rochester, is run to all fires in order that such wires as may be necessary may be speedily cut. The top and bottom of the truss are separate and furnished with partitions which form openings or pockets through which lines of standard hose may be run to the number of a dozen, and this number of lines of hose may be passed and be entirely free from danger of passing trolleys. In severe test no movement of the bridge was discernible.

Prospects are good that Buffalo will soon have another great electric road connecting it with the country localities thereabouts, as the route of the proposed Buffalo, Hamburg & Aurora road has been surveyed and mapped out. This line will begin at the Buffalo city line on the Abbott road and follow that highway to the village of Hamburg. At Titus Hill station, where the Buffalo, Rochester & Pittsburg railroad crosses the Abbott road, a slight detour is made to the east and the trolley will pass under the railroad bridge. Beyond this point about a mile the East Aurora branch leaves the Abbott road and follows the main line into Webster's Corners. On leaving this village the line follows the old plank road south to Orchard Park, thence east to the village of East Aurora along the Big Tree road. While it crosses the line of the B., R. & P. road twice, in both cases it runs beneath the railroad. In length the proposed line will be about 18 miles. A large patronage is expected from all the villages through which it passes. The equipment of the road is expected to be very similar to the Buffalo-Niagara Falls line, with 90 pound girder rails. The trip from end to end is expected to take about one hour. The Buffalo, Hamburg & Aurora Railway company was incorporated on March 16th last, its capital stock being $200,000. The officers are: W. W. Wheatley, president; A. W. Hickman, vice-president; U. L. Upson, secretary; J. A. Donaldson, treasurer; while the board of directors is composed of the above named and A. J. Benzing, L. J. Close, Dr. Ernest Wende, G. R. Vaughan, Willis G. Gregory, W. J. Wright, Dr. Loran F. Boles and Frank W. Everett. Mr. Wheatley is the superintendent of the Brooklyn Heights Electric Railway company.

TELEPHONE.

The Bennettsville (S. C.) Telephone company has been incorporated with Knox Livingston as president and H. H. Newton, Jr., secretary and treasurer.

It is intended to add two telephone cables to the international submarine service now in operation between England and France. This acquisition will increase the number to six.

Thomas J. Wright, Claude D. Long, Edwards Story and others have obtained a charter for the La Belle (Mo.) Telephone Construction company, which has a capital of $4,000.

The Michigan Legislature has refused to pass a bill which provided that where rates for telephone service were reduced to shut out competition the lowest rate should govern in all cities of like population.

The capital stock of the Bell Telephone company of Missouri is to be increased from $400,000 to $2,000,000, five times the present figure. A special meeting of the stockholders of the company has been called for this purpose. The meeting will be held in St. Louis on July 1st.

The Southern Bell Telephone company has reduced its rates to $6 per year at Staunton, Va., the rate to go into effect if a sufficiently large number of subscribers can be secured to justify the reduction. This is understood to be an effort to drive the Mutual company out of business.

MISCELLANEOUS.

C. H. Mitchell of Toronto, Ont., suggests the use of scrap or refuse mica in making coverings for boilers and steam pipes, where its properties as a non-conductor of heat will be valuable. Another use is as packing or protection to walls or roofs exposed to heat, or in other locations as a fire-proof material.

E. D. Smith & Co., the contractors on the extension of the Niagara Falls Power company's wheel-pit, have received 28 huge blocks of granite from Massachusetts quarries to be used as a base on which will rest the 4½ ton castings to support the wheel-cases and penstock elbows. Each block is about six feet long, two feet thick and 4½ feet wide, and weighs about 9,500 pounds.

The Order of Railway Telegraphers convened on May 17th at Peoria, Ill., with about 115 delegates present. The address of welcome was delivered by W. V. Tefft, city attorney, to which Grand Chief Powell responded. W. S. Carter, editor of the *Locomotive Fireman's Magazine*, welcomed the delegates on behalf of the sister railway organizations. Speeches were also made by A. D. Thurston of Vinton, Iowa, and Paul G. Ramsey of Chicago, past grand chiefs; J. R. T. Austin, grand secretary and treasurer, and T. M. Pearson, second assistant grand chief. The federation of railroad organizations and formation of a ladies' auxiliary were favored by the speakers.

A carrier has no right to imperil the lives and safety of passengers by insisting upon its legal rights. Its primary duty is the care for the safety of its passengers, and not the assertion of its full legal privileges. To illustrate, the Appellate Division of the Supreme Court of New York further says, April 9, 1897 (Loudoun vs. Eighth Avenue Railroad company), in an action brought to recover damages for personal injuries sustained in a collision of street cars, that the carrier of the plaintiff was bound, even by a yielding of the right of way which it seemed to have possessed, to have avoided this collision if it were possible. And from the fact that its car was struck at the rear end, the court holds that it apparently had the right of way, and the other company was also in fault.

TRADE NEWS.

The National Tube Works company of McKeesport, Pa., has issued a catalogue entirely devoted to steel trolley poles. The subject is exhaustively discussed, and much valuable construction data is given.

It is reported that the Hunter corporation has made a proposition to the General Electric company to purchase all of the numerous patents of R. M. Hunter of Philadelphia relating to railway work and alternating systems which it now controls or is licensed under, offering something like $500,000.

C. H. Wilmerding, general superintendent of the Chicago Edison company, will open an office as consulting engineer at 1590 Old Colony building, Chicago, on June 1st. As already announced, Mr. Wilmerding will engage in general engineering work, but will make a special feature of electrical plants, for which his experience particularly fits him.

The Brush Electric Light & Power company, Galveston, Texas, has placed an order with the Ball Engine company, Erie, Pa., for a 450 horse power horizontal cross-compound engine, which is to be direct-connected to a Stanley alternating machine. The city of Okolona, Miss., is about to put up a waterworks and electric light plant. The engine for the electric plant will be purchased from the Ball Engine company.

Under date of May 21st the Ward Leonard Electric company of Hoboken, N. J., makes this statement: "We wish to notify you that our works were destroyed by fire on the night of the 20th inst. and are a total loss. We are to-day arranging to immediately resume the manufacture of our rheostats, circuit-breakers and outlet boxes in a vacant factory which is well suited for our work, and we expect to be able to execute the orders you now have with us, and also to supply your future wants with the least possible delay."

The Midland Electric company is the name of a new manufacturing concern just formed in Chicago, with offices at 1564 Monadnock building. Joseph Kettlestrings, the manager of the company, has long been identified with electrical interests in Chicago, and withdraws from a large electrical manufacturing company to take charge of the interests of the company he now represents. The new firm promises a superior line of alternating arc lamps and transformers, and will also give its attention to general electrical engineering work.

BUSINESS.

G. F. Brunt has purchased the entire interest of his former partner, C. F. Thompson, in the porcelain electrical supply business formerly carried on by Brunt & Thompson of East Liverpool, Ohio, and will continue the business with a full line of porcelain for electrical purposes.

The Erie (Pa.) Gas Engine company tells of the merits of the Erie gas engine in an attractive catalogue. Especial attention is directed to the strength and solidity of the engine and to its record. The company claims that its engines "are in every way superior to each and every other gas engine in existence."

The Chicago Edison company, 139 Adams street, Chicago, calls attention to the line of Paragon fan motors which it carries in stock. It guarantees all fan motors, and will replace any burned-out parts if the injury is caused by a mechanical or electrical defect. The company also carries a full line of electric lighting supplies.

The Standard Telephone & Electric company of Madison, Wis., reports a very satisfactory condition of business, and within the last 10 days it has closed orders for several exchange installations. The high-grade character and non-infringing features of the apparatus manufactured by this company are explanations offered for its constantly increasing business, to meet which it has recently added largely to its factory force.

The increasing demand for the product of Roth Bros. & Co. has made it necessary for this enterprising firm to move into larger quarters. It can now be found on the second floor of 30-34 Market street, Chicago, having

been previously located on an upper floor of the same building. The company now occupies three or four times as much floor space as formerly, which is doubtless an indication of the appreciation in which users hold Roth apparatus.

The F. & C. motor switches constitute a new line of goods which the Electric Appliance company has recently added to its already extensive stock. The F. & C. switches are said to meet the requirement for a low-priced motor switch in capacities of 35 and 65 amperes. The Electric Appliance company will be pleased to send special prices on these goods on application.

The Central Electric company states that the fan motor business is opening up with unusual activity. The line of Lundell fan motor apparatus handled by this company has been quite considerably increased this year, and, with the addition of the Wagner ceiling fan motor and the Emerson induction fan motor, it claims to have the most complete line of ventilating apparatus. The Central's 1897 fan motor catalogue is an unusually fine production of the printer's art, and it will be sent to anyone interested on application.

The Fiberite company, Mechanicville, N. Y., manufacturer of the Medbery material, is furnishing a complete line of street railway overhead equipment, using aluminum bronze metal, combined with a composition that is waterproof, practically indestructible, of great tensile strength and of the highest electrical resistance. This company makes everything that pertains to overhead equipment of electric railways, and the fact that the works are in operation 24 hours a day is proof of the high standing of the products. For over six years this material has been on the market, and its great popularity is due to its superior insulating qualities and the fact that it is always as represented. The Medbery company is also furnishing a line of malleable iron fittings, combined with the Medbery insulation, at as low prices as these goods can be sold. Large quantities of this material are being exported. The Medbery insulation has been adopted by many of the best roads in the country, and it is said that in every case satisfaction is obtained. The Medbery knife switches, now so well known among central station men, also the Medbery motor switches, switchboards, panel boards, as well as high potential switches for street railways, are finding a ready sale through the country and are known for their quality and for large carrying capacity. The Chicago agents are S. F. B. Morse & Co., Marquette building.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 18, 1897.

582,615. Electric Lock. Henry Bezer, New Rochelle, N. Y. Application filed October 25, 1892.

An improved electric lock is described, consisting of a latch, a main locking-piece arranged to engage the latch, an armature connected to such main locking-piece, an electro-magnet and an auxiliary locking-piece, the auxiliary locking-piece being arranged to disengage the main locking-piece from the latch, and itself temporarily engage the latch.

582,640. Machine for Forming Armature Coils. Gustaf A. Grisell, Madison, Wis. Application filed November 16, 1896.

A device for forming armature coils comprises a forming part to receive one side of the coil, another forming part to receive the other side of the coil, two forming parts to receive the ends of the coil, the latter parts comprising standards provided with a table having a slot therethrough, a second table provided with a shank adapted to fit in said slot, and a connecting device adapted to connect said shank and standard together.

582,649. Electric Advertising and Display Apparatus. John L. Killmer, New York, N. Y. Application filed March 2, 1896.

One or more Geissler's tubes are bent and arranged to represent symbols or letters, and have a portion of the symbol or letters of a word different in color from the remainder of the symbol or word.

582,663. Electric Controller. William H. Morgan, Alliance, Ohio. Application filed November 14, 1896.

One claim is for the combination with an open shell having a ring or flange at one side, a spider made integral with the ring or flange, and braces for the spider made integral with the shell, of frames secured to the ring or flange and insulated therefrom, contact-plates attached to the frame, a shaft mounted in the spider, means for operating the shaft, a contact-arm secured to the shaft, and having contact-brushes to move over the contact-plates, and sheet metal plates closing the open portions of the shell.

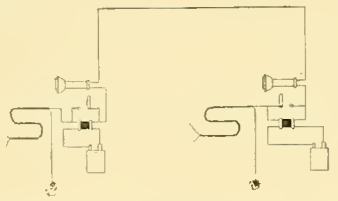
582,664. Electric Arc Lamp. John A. Mosher, Chicago, Ill. Application filed December 17, 1892.

The combination is described of an electro-magnet, an armature under its influence but separated therefrom by a non-magnetic block or substance, and a spring connected with and influencing the armature in the same direction as the magnet, all so arranged that when the armature is least influenced by the magnet it is most influenced by the spring.

582,665. Electric Arc Lamp. John A. Mosher, Chicago, Ill. Application filed January 19, 1894.

There is the combination with the lamp frame, of a thermo-expansive wire, a clutch carried by the upper carbon rod, a pivoted lever having a tooth adapted to project under one edge of the clutch, the lever being pivotally connected to the wire, one or more springs for lifting the free end of the lever, two fixed supports and an adjustable support for supporting the clutch in a horizontal position independently of the lever.

582,694. Electric Searchlight. Samuel W. Rushmore, Brooklyn, N. Y. Application filed January 11, 1896.



NO. 582,773.

The inventor claims the combination of a searchlight, a supporting yoke therefor, a shaft and handle for turning the same in a horizontal plane, a second shaft movable separately from first, parallel but not concentric therewith, and a connection between the shaft and the searchlight for moving it in a vertical plane.

582,698. Electric Rail Bond. George H. Scott, Worcester, Mass. Application filed July 17, 1896.

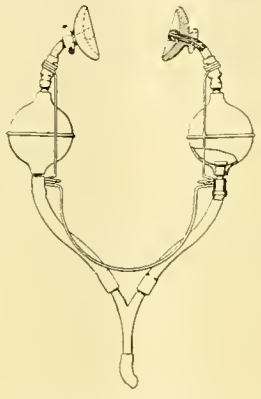
The claim: The combination of the rail sections having openings of unequal diameters at different points in their lengths, with an electric bond device comprising a connecting rod of cylindrical shape at the ends where it fits into said rail-section openings, and two cylindrical-shaped tubes or collars adapted to fit over said cylindrical ends of the connecting rod and to be driven into the openings in the rails against the beveled surfaces thereof, and thus, by said driving operation, causing a longitudinal compression and lateral expansion of the metal, so as to completely fill the openings and form a tight fit therein, said driving operation also causing the connecting rod to be compressed laterally, and its metal forced out longitudinally and expanded.

582,714. Telephone Toll Apparatus. Frank M. Archer, New York, N. Y. Application filed April 30, 1896.

In a telephone toll apparatus operated by the insertion of a key a main shaft is adapted to send in a call when rotated in one direction, and to entrap the key when rotated in the opposite direction.

582,721. Electrode. James A. Deuther, Boston, Mass. Application filed August 19, 1896. Patented in England September 17, 1896.

An electrode is made in sections, three or more, one end section composed of a material which is a non-conductor of heat and electricity, the other end section composed of a material which is a conductor of electricity, and is adapted to be exposed to the action of an electric arc, and a section composed of a heat non-conducting material which is a conductor of electricity placed intermediate of the end sections, a means for removably connecting the sections, and a means for conducting electricity through the section composed of a material which is a non-conductor of heat and electricity into the intermediate section.



NO. 582,901.

582,772. Method of and Apparatus for Preventing Formation of Arcs When Opening Circuits. Thorsten von Zweigbergk, Cleveland, Ohio. Application filed October 29, 1896.

A device for reducing arcing when opening an electric circuit consists of a movable segment adapted to make and break contact with stationary contact-points, an insulated end piece on the segment, a line connection between the segment and its insulated end piece, resistances in the line connection, and means for cutting the resistances in and out of the line connection.

582,773. Telephony. John Absterdam, New York, N. Y. Application filed May 27, 1892.

An open main line is subjected to the magnetic influence produced by a constant current in a local line or circuit, and means independent of the local circuit for transmitting speech are provided by originating variations of magnetical condition corresponding to speech.

582,840. Electric Switch. Elmer H. Wright, Chicago, Ill. Application filed March 13, 1896.

This is a blade-switch, combining a fixed contact-blade and a movable contact member of female form, parallel resilient blades secured together at each end by suitable spacing devices, and adapted to receive the fixed blade between them.

582,849. Rail Bond. Fred H. Daniels, Worcester, Mass. Application filed February 10, 1897.

A flexible rail bond, comprising a flexible body portion, and two terminals are made separate from the flexible body portion, and secured thereto by pressure to be substantially integral therewith.

582,862. Circuit Breaker for Trolley Wires. Charles Hoff, Cincinnati, Ohio. Application filed January 22, 1897.

A safety circuit-breaker device or hanger for trolley and other electric wires is composed of a suitable main bar or frame having downwardly turned forked ends, a pair of contact levers or plates swung in the forked ends toward each other, and having their inner flared ends lying normally contiguous and completing circuit within an open socket frame hung from the main bar or frame, a pair of auxiliary coil-springs stretched between the bar and the inner ends of the contact levers, and a pendent wedge or guide at the center of the main bar or frame, the wire being suitably attached or connected to the respective outer projecting ends of the contact lever.

582,882. Trolley for Electric Railways. Sidney H. Short, Cleveland, Ohio. Application filed December 22, 1896.

The trolley arm described has at its free end two laterally extended insulated forks, with a roller mounted in the forks. There are two insulated end sections and an annular external flange.

582,884. Brush Holder for Dynamos or Motors. Sidney H. Short, Cleveland, Ohio. Application filed February 16, 1897.

The combination of the commutator of a dynamo or motor, with a radially adjustable bar which is parallel with a commutator bar, and has an inclined lower face which is inclined at less than a right angle to a tangent to the commutator at the point of brush-contact, and means for holding a brush against the inclined face, and for forcing the brush inward into contact with the commutator surface.

582,889. Automatic Electric Gate. James M. Williams and Thomas P. Kinney, Danville, and Harry W. Kinney, Lynchburg, Va. Application filed August 18, 1896.

An electric motor is connected with a railway gate; an electrical generator is in circuit with the motor; track instruments are in a circuit controlling the motor circuit; a magnet and an armature control a circuit-closing brush, and a commutator co-operates with the brush and arranges to move with the gate shaft, the commutator holding the motor circuit closed during the movement of the gate shaft.

582,901. Receiver for Telephones, Phonographs or Similar Instruments. Charles W. Dennis, King's Ferry, N. Y. Application filed August 7, 1896.

This article consists of a receiving tube or cord having branches engaging the same, a hollow rubber ball or bulb secured to each of the branches, earpieces, shanks secured thereon, heads on the shanks, a short tube which passes therethrough, a head on the end of the tube, the tubes engaging the balls or bulbs, a spring-wire yoke engaging the lower ends of the tubes, spring coils in the sides of the yoke.

582,907. Insulating Fish Plate. Frederick T. Fearey, Newark, N. J. Application filed March 22, 1897.

One claim is for the combination with the fish-plates, having the vertical portion with inclined bearings at the upper and lower edges, and having at its lower edge a hollow flaring extension to receive the flange of the rail, of an insulating lining plate extending over the opposite inclined bearings and into hollow extensions.

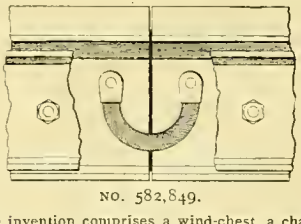
582,910. Electrical Conduit. Jacob J. Grnshans, Buffalo, N. Y. Application filed December 5, 1896.

A conduit consisting of two series of pipes, one within the other, one series being sealed by a material impervious to moisture, and the other series by a non-conductive material.

582,913. Telephoning from Cars. Manious Garl, Akron, Ohio. Application filed January 10, 1896.

One or more pairs of circuit-controlling springs are located at intermediate points along the line, the springs being normally in contact to complete the circuit; a portable hole is provided with arms forming terminals of a circuit, and arranged to make contact with terminals located in close proximity with the contact-springs, and to break the circuit formed by the springs when the pole is placed between the latter, and a field telephone connected with wires located within the pole and in connection with the arms.

582,918. Electro-pneumatic Organ Action. Hermann E. Hobbs, Weston, Mass. Application filed May 21, 1896.



NO. 582,849.

The invention comprises a wind-chest, a chamber connected by ports with the wind-chest, an exhaust valve for the chamber, a pneumatic for controlling the exhaust valve, an electro-magnet, the armature of which forms a valve for controlling the inlet ports, the valve also controlling a leak passage leading from the chamber, and a key adapted to open and close the circuit for the electro-magnets.

582,923. Electrolytic Apparatus. Alfred E. Hunt, Pittsburg, Pa. Application filed December 4, 1895.

A number of pots or vessels are electrically connected in series, the several pots or vessels having metal platforms in electrical connection therewith, so that they shall be maintained at the same electrical potential as the pot.

582,936. Electrode. Wilhelm Majert, Falkenberg, Germany. Application filed May 5, 1896.

An electrode is described, comprising a conducting frame having approximately parallel inwardly projecting flanges forming an interior groove in the fame, and a filling of an active mass set in the groove of the frame and engaging the parallel surfaces of the flanges, the outer surface of the mass being spaced from the opposing surface of the frame, whereby the active mass may expand without causing a deformation of the frame.

Western Electrician.

EVERY SATURDAY.

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Sciagraphs Play Important Part in Action for Damages at Lockport, N. Y.

By Orrin E. Dunlap.

The largest verdict for damages ever returned by a jury in Niagara county, New York, was in a case where a sciagraph was an important feature of the evidence submitted. The case was that of Jacob Smith against the New York Central & Hudson River Railroad company. The attorneys for the plaintiff were Ely, Dudley & Coho of Niagara Falls, and when the case was heard in Lockport it was tried by Morris Cohn, Jr., assisted by Frederick Chormann. The summons recited two causes of action, the first for damages alleged to have been sustained on or about March 30, 1893, while working on the New York Central bridge across the Niagara Falls Hydraulic Power & Manufacturing company's canal in Niagara Falls, and for which damages to the extent of $5,000 were demanded. But the action in which the X-ray played such an important part had its origin on a bridge near Spuyten Duyvil, N. Y., across the Harlem river, and was for $20,000. This bridge was of the variety known as the "jack-knife draw," and was constructed so that it, or part of it, could be raised or lifted so as to permit of boats and vessels passing through or under it. The complaint alleged that on July 28, 1895, the defendant was engaged in repairing this bridge, and for that purpose had taken from one of the towers within which were located the weights by which the bridge was elevated when required, a very large iron casting weighing upward of 4,000 pounds, and that the defendant having repaired the weight had prepared to hoist it to the top of one of the towers of the bridge for the purpose of replacing it.

At this time the plaintiff was employed by the New York Central as a blacksmith, and while engaged in his occupation at the bridge he was called from his usual place of work and duties and directed to get upon the top of the weight and remain there while it was being hoisted, by means of pulleys, to the top of the tower. Smith followed instructions and when the weight was about 35 feet from the ground it fell, precipitating the plaintiff with it, and inflicting upon him severe injuries. Smith is 35 years old, and the claim was made that as a result of his injuries he would be prevented from earning a livelihood hereafter for himself or for those depending upon him. His injuries as described in court were a crushing and breaking of his right ankle, rendering it useless forever; his right hand was paralyzed, his left shoulder dislocated, internal injuries and many cuts and bruises were received, and he had suffered great mental and physical pain, so said his attorneys.

Smith was treated in the Lexington Heights hospital, Buffalo, by Dr. De Witt G. Wilcox, and when he went there he was suffering from a badly deformed foot. The injured leg was an inch shorter than the other and the foot an inch longer. Until examined by the Röntgen rays, it was difficult to make out the exact nature of the injury. This examination showed clearly a dislocation of the bones of the foot from the bones of the leg. Normally the long bones of the leg rest upon the arch of the foot with a long projecting bone behind, which makes the heel. In Smith's case the long bones have been forced backward from the arch and now rest on the projecting heel, thus making the leg shorter and the foot longer, also allowing no ankle movement. This state of affairs is well displayed in the accompanying illustration, the original plate of which was taken by about 30 minutes' exposure.

The jury in the case reported a verdict of $10,800 in Smith's favor, which is said to be the largest verdict for damages ever given in Niagara county.

SCIAGRAPHS PLAY IMPORTANT PART IN ACTION FOR DAMAGES AT LOCKPORT, N. Y.

A New Fluoroscope Screen.

By W. M. Stine.

This screen is new only as regard the methods for its preparation. The fluoroscope is of the now well-known form first introduced by Aylesworth and Jackson, but the calcium tungstate screen has given place to one coated with the material first suggested by W. C. Röntgen, barium platinum cyanide. After a long series of experiments, Messrs. Aylesworth and Jackson have succeeded in preparing this chemical in a highly sensitive and finely divided condition. This is mixed with a transparent adhesive varnish and applied evenly and thickly to the screen. The result is a smooth fine-grained surface, in contrast with the rough, sandpaper-like appearance of the calcium tungstate screen. Long experience has indicated that the screen of the fluoroscope should be covered with a substance in which there no perceptible grain or crystals. The more nearly it approaches an impalpable powder the sharper will be

the definition of the shadows. While the later screens of calcium tungstate have been very sensitive to the Röntgen rays, the coarseness of the crystals employed seriously interfered with their use in diagnosis, especially when minute structures were to be viewed.

Each gain in sensitiveness has increased the delicacy and accuracy of fluoroscopic diagnosis. This new screen shows a marked increase in sensitiveness over any yet tried. In addition, the light from the screen has a yellowish tint, and so fatigues the eye less than the bluer cast of the calcium tungstate fluorescence.

The screen shows but little phosphorescence. As a result, the differentiation between shadow intensities can be made with ease.

The ideal screen must be as sensitive as possible and entirely free from phosphorescence.

Those interested in work with the Röntgen rays are under renewed obligations to the makers of such screens and they should be encouraged to continue experiments which shall provide more and more sensitive screens.

What Equipment the Law Requires for Electric Railways.

Roughly expressed, the Supreme Court of North Carolina holds that the safest course with regard to the adoption of appliances for the protection of passengers on electric railways is laid down in the lines:

Be not the first by whom the new is tried,
Nor yet the last to lay the old aside.

In an action brought to recover damages for personal injuries declared to have been sustained on a street railway because of alleged negligence in the company permitting its car to run down hill at a rapid speed and without proper appliances, whereby the car was derailed, the principle was considered. The governing law, so the jury was instructed, was that it was the duty of the company to provide its cars with all known and approved machinery necessary to protect its passengers from injury. But this the Supreme Court pronounces too broad and exacting a statement, and, on account of it, reverses a judgment given the plaintiff. (Witsell v. West Asheville & Sulphur Springs Railway company, April 30, 1897.)

No distinction seems to be recognized by the court between what is required of steam railways and of electric street railways so far as the adoption of new appliances for the safety of passengers is concerned. It says that the carrier must not be lacking in any appliances which sound rules require it should have, but it is not bound to use every means scientific skill might suggest to prevent accidents.

Whether an electric railway company is negligent not to have a certain appliance, the court maintains, depends, not upon the bare fact that its use would conduce to greater security, nor upon its being "known and approved" or "the latest and best." But the correct, as well as more reasonable and just, rule, it says, is more nearly this: "It is negligence not to adopt and use all approved appliances which are in general use and which are necessary for the safety of passengers." The courts cannot act precipitately in such matters. Before they will declare it negligence not to adopt improved appliances and machinery, there must something more appear than that the latter are "known" and "approved."

The law is reasonable and just alike to the carrier and the passenger. It does not require the carrier to adopt each appliance as soon as "known and approved," nor will it justify the retention of old appliances when new and better ones are in general use. Hence the applicability of the well-known homely lines quoted in the beginning.

That it would be too burdensome, and discourage the building of new roads, if every railway company were held to so strict a rule that it must keep a lookout for improvements and inventions, and when such are "known and approved," buy them, or pay the penalty attached to being held guilty of negligence, the court clearly recognizes. So it characterizes the rule requiring it as unreasonable and compliance with it impracticable. At the same time, it says that if an appliance is such that the railways should have it, the poverty of a company is no excuse for not having it.

Another Bridge at Niagara Falls.

Several months ago it was announced in these columns that the owners of the upper suspension bridge at Niagara Falls intended to replace the structure by a new steel arch. Since then the old railway suspension bridge has been succeeded by an arch described in the Western Electrician. On the morning of Thursday, May 27th, bids were opened for the construction of the first-mentioned bridge, and the prospects are that within a few weeks the contract will be awarded and work on this second great arch to span the Niagara gorge commenced. The proposed arch will be somewhat different than the one just built, inasmuch as the span will be longer and the arches will be built on the parabolic principle. This bridge will be of interest in the electrical field because the plans call for double tracks for trolley cars, broad carriageways and walks for foot passengers. The double tracking of this structure for trolley cars will make it possible to operate a belt line about a most interesting section of the beautiful Niagara gorge, while the proposed construction of a bridge at Lewiston will make it possible to connect the Gorge road and the Niagara Falls Park & River road at that point.

Trolley Car Robber Escapes.

"Jack" Carr, one of the men convicted of the Evanston trolley car robbery, who has been confined at the Cook county hospital since April 18th, suffering from a bullet wound in the breast received during a running fight with Officer McSweeny of the West Lake street station, Chicago, escaped from that institution Thursday evening, May 27th, and has not yet been captured. Carr's apprehension and conviction were secured at considerable trouble and expense, and it is not believed he will now be permitted to escape punishment.

A. D. Ellsworth & Co. have applied for an electric light franchise at Cedar Falls, Iowa.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part VII.

Connections between Engines and Generators.

In every power station some method must necessarily be adopted to drive the electric generators by the steam engines. The principal methods used in modern plants may be enumerated as belting, rope driving and direct connection.

Occasionally some form of friction or toothed gearing is resorted to under special circumstances. Sometimes a form of friction pulley is used for running the dynamo directly from the engine fly-wheel, in which case a continuous leather belt is inserted between the fly-wheel and the pulley, which serves the purpose of adding to the friction and preventing noise and vibration. Spur gearing is also used for driving dynamos, but not to any great extent in connection with steam engines. If the load on the generator is a steady one, the principal objection that can be found to the use of toothed gearing is that of noise, but the fact remains that up to the present this method is not popular with the designers of power stations. As both friction and gearing connections are usually adopted only under conditions where the use of one of the methods mentioned in the first paragraph becomes impossible, we will confine our attention to these three principal systems.

Belts are made, as a rule, of either rubber, cotton, leather or a combination of these materials. For driving dynamos rubber belts have a single — perhaps doubtful — recommendation, and that is that by their use a better grip can be obtained upon the pulley than with any other kind. However, they are not as strong as leather belts, and therefore cannot be subjected to as great a tension. In relation to durability it will be found that rubber belts have a considerably shorter life than leather belts, as they are easily injured by heat, very quickly rotted if allowed to come in contact with oil; and if allowed to slip upon the face of the pulley, as may happen in case of short-circuits, they are very seriously injured by heating or abrasion. If abraided in one place the whole belt is ruined, as there is no way of successfully splicing a rubber belt, except to lace it, which is objectionable. It is true that a rubber belt will stand the effects of moisture much better than any other, but it will be seldom that a generator is to be operated in a location so damp as to affect leather or cotton belting. Finally, rubber will be found to cost so much more than leather or cotton that its use will be found advisable only under particular conditions where moisture must be considered. Cotton as a material for belting has many advantages over rubber. It makes an inexpensive belt, which, on account of its lightness, adds little weight to the shaft bearings. Cotton belts are less liable to injury, either from heat, oil or slipping, than rubber belts, and will therefore have a longer life. In the matter of tensile strength and durability cotton belts stand midway between rubber and leather, and for many purposes are the cheapest belts to buy; but for satisfactory working under all ordinary conditions there is no material that will give as universal satisfaction as leather.

Leather used for belting should be most carefully selected and treated. The best belts are oak-tanned and made from "center" stock only—that is, a narrow width of the hide laying on both sides of the backbone. They come in three standard thicknesses, "single," "light double" and "double," though for large powers they are made triple and quadruple. Leather belts are sometimes perforated, the slits being made with their longest dimension in the direction of the length of the

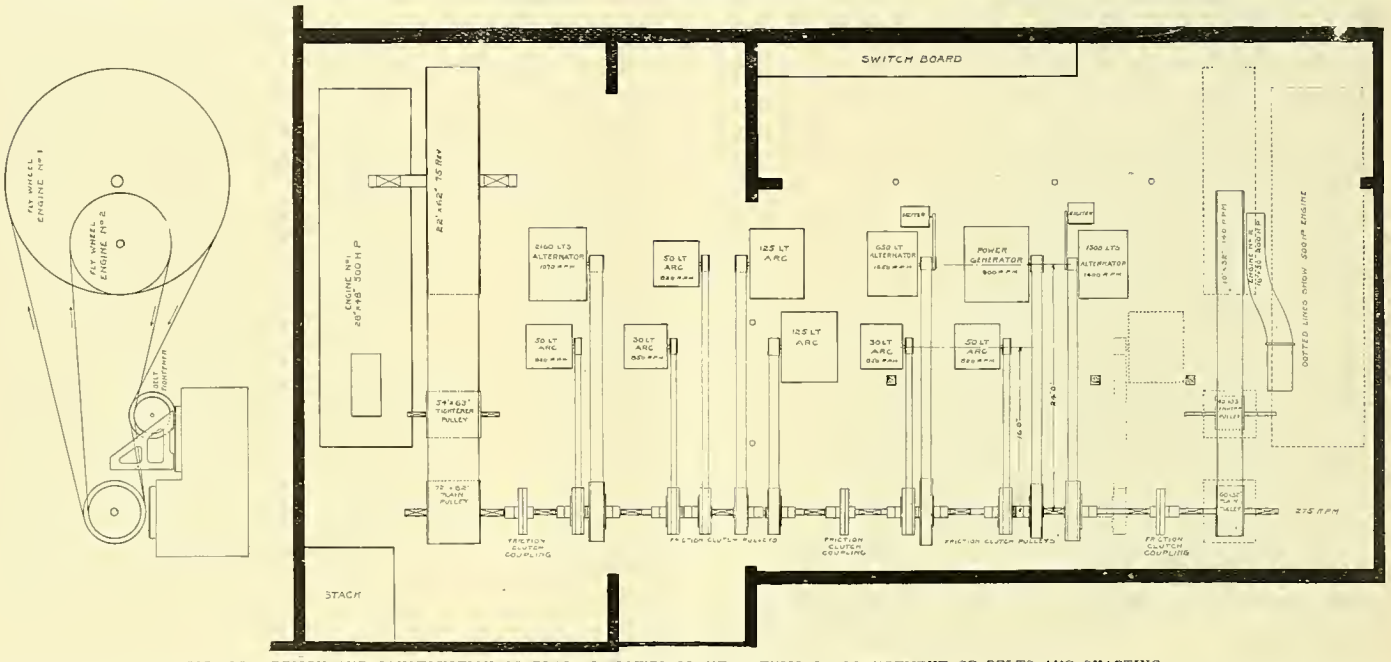

FIG. 35. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPICAL ARRANGEMENT OF BELTS AND SHAFTING.

belt. These perforations allow the film of air which is thought to collect between the pulley and belt to escape and result in a better adhesion to the pulley. This method is beneficial, especially with high belt speeds. Link belts, made of small links of leather joined together by iron bolts or rivets, are sometimes used and may be advisable in certain cases, where the distance between centers is very short. This form of belt allows of a greater arc of contact on account of the sag which may be allowed in the upper side, and this allows the belt to secure a better grip upon the pulleys. However, the extra weight of link belts causes greater strain upon the bearings, and this probably more than offsets the advantage of an increased grip.

Cotton-leather belting is sometimes made in an attempt to combine the advantages of both cotton and leather belts. This belt is thought to secure the desirable qualities of lightness, durability, cheapness, smoothness and quietness of running. The leather side is made the pulley side, thus obtaining a good grip. Belts of this character are especially suitable for use where the design of the station requires that the belt run vertically. In such a case the grip upon the pulley is obtained by keeping the belt very tight, and to this end the flexibility of the cotton-leather belting is of advantage, and as it stretches but little it seldom requires resplicing.

There are a number of formulæ for determining the horse power transmitted by a given belt. A usual rule among engineers is to allow one horse power for each inch width at a speed of 1,000 feet per minute. This applies to "single" leather belts about three-sixteenths inch thick and an arc of contact of 180 degrees. If the speed is more or less, the power changes in the same proportion. If the arc of contact is not 180 degrees, the value may be multiplied by the following constants:

90	degrees	.65
110	"	.75
130	"	.83
150	"	.91
170	"	.97
200	"	1.05

If the belt is not "single," the value in the rule should be multiplied by 1¼ for "light double" and by 1½ for "double" thickness.

The rule of one horse power transmitted by a one-inch single-thickness belt traveling 1,000 feet per minute gives

$$(1)\quad \text{H. P.} = \frac{W V}{1000} = \frac{W \times R \times \pi \times D}{1000 \times 12} = \frac{W \times R \times D}{3820}$$

Where W = Width of belt in inches.
V = Velocity of belt in feet per minute.
R = Revolutions of pulley per minute.
D = Diameter of pulley in inches.

This rule allows a working strain of 33 pounds per inch of width, which is certainly very low. Safe practice would certainly allow 45 pounds per inch width, in which case we have

$$(2)\quad \text{H. P.} = \frac{W \times 45 \times \pi \times D \times R}{33000 \times 12} = \frac{W \times R \times D}{2800}$$

If the belt is working on a comparatively steady load, as with a lighting generator, the second formula will give good working values, but if the load is subject to sudden and violent fluctuations, as in railway work, the first formula will be the best one to use. Kent's handbook gives an interesting comparison of various belt formulæ, and shows quite a wide difference. The fact is, formulæ should be used with considerable care, and the conditions of service, tension and atmosphere should be considered in determining the proper width of belt for a given installation, the object always being to transmit the amount of power required with as light a tension on the shaft bearings as possible.

Shafting.—It is often convenient to so arrange the power plant that a number of the generators can be operated by two or more engines. A type of such an arrangement is shown in Fig. 35, which shows the line shaft of a recently reconstructed plant. Each engine is connected to the main shaft by means of a belt driving a rigid pulley on a short piece of shaft called a "jack-shaft." This short shaft is attached to the main shaft by means of a friction clutch coupling, and each pulley carrying a dynamo belt is equipped with a friction clutch pulley. The shafting is divided at about the center, and a friction clutch coupling is placed to connect the two ends. This arrangement results in great flexibility, as any dynamo can be thrown in or out at will. The load on the shaft at any one time can be carried by either engine until the demand becomes greater than its capacity, when the other engine may be started up and made to take its share of the load. By releasing the coupling in the middle of the shaft, each engine may be made to revolve the piece of shafting immediately contiguous to it, which makes it possible, by properly arranging the generators supplying the day load, to operate the plant for a good share of the time by an engine of suitable capacity without running the entire length of shaft. All these changes may be made without interfering in any way with the running of any part of the plant which it may be desired to operate continuously.

The friction clutch couplings referred to are constructed in a number of ways, the object being to press two surfaces together so that their friction will overcome the resistance of the driven shaft. This may be accomplished by means of jaws arranged to clamp tightly a revolving rim; by means of a cone sliding or a feather engaging another cone keyed rigidly to the other shaft, or by expanding an interior ring against an outside one. The clutches are operated by means of a lever or a hand-wheel, conveniently placed, which in turn acts upon a system of toggle joints or through screws, so that the clutches can be thrown in gradually and released quickly. A type of a friction clutch pulley is shown in Fig. 36. Here the jaws, which are faced with hardwood blocks, are operated by a toggle joint and grip tightly the iron rim cast upon the pulley. When the jaws are thrown open by means of the sliding collar, the pulley turns upon the shaft as an idler. Whenever friction clutch pulleys are used the hubs should be provided with removable bronze or other alloyed bushing, made in halves so that they can be removed and renewed quickly in case of excessive heating or wear. Each pulley and its clutch ring should be split to provide for easy repairs and for future changes. The friction clutch couplings need not be split, for they are at the ends of the shaft, where they can be easily removed, although it is preferable to have them divided.

Shafting is "cold-rolled" or "turned," depending on whether it is rolled the exact size for use or is turned down in a lathe. Of the two the latter is to be recommended, as it is more liable to be perfectly straight. When a cold-rolled shaft is fitted with keyways or shoulders the initial strains in the metal may be affected

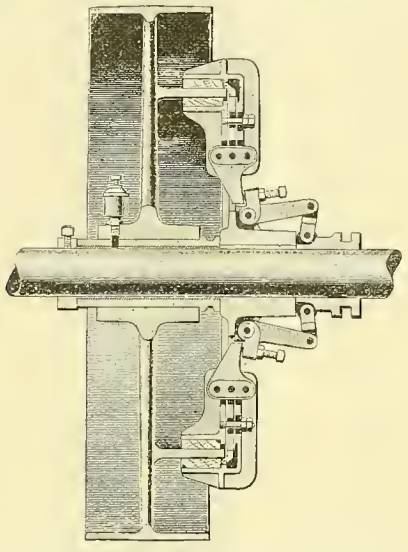

FIG. 36. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—SECTION OF TYPICAL FRICTION CLUTCH PULLEY.

so that the shaft is liable to spring or bend. To obtain the diameter (d) of a shaft the following formula will be found safe for any given horse power (H. P.):

$$d = \sqrt[3]{\frac{(\text{H. P.}) \times C}{\text{r. p. m.}}}$$

Where C is a constant depending upon the material of which the shaft is made and the conditions under which it works, as shown in the table:

Values of C.

Variety of Shafting.	Turned Iron.	Cold Rolled Iron or Steel.
Shafting carrying main driving pulley	125	75
Line shafting with bearings eight feet apart	90	50
Shafting transmitting power subject to torsional strain only	50	30

For main line shafts in power houses containing a number of generators the size of shaft will ordinarily be between 5 and 6½ inches in diameter with floor-stands not more than eight feet apart. In shafts four inches in diameter and over, the sizes are standard in steps of one-half inch, while in sizes below four inches the steps vary by quarter-inches; and the exact diameter in the smaller sizes is less than the even quarters by one-sixteenth inch, on account of the amount taken off by the lathe tool in finishing.

Safe Rules for Belting and Shafting.—In laying out a belted plant it is well to keep in mind the following rules:

Place the generators, if possible, so that the tension side of the belt will be underneath and the sag will tend to increase the arc of contact.

If a belt tightener is used, it should be applied to the slack side of the belt and near the smaller pulley. A belt tightener is shown in the end elevation of Fig. 35.

The belt speed should be about 4,500 to 5,000 feet per minute for generators, and it is well to make the pulleys as large as this speed will allow. Where the line shaft is driven by a belt running on the fly-wheel of the engine, the speed often reaches 5,200 feet per minute.

The best distances between centers has been found to be as follows:

With narrow belts and small pulleys, not less than 12 to 14 feet.

With larger belts and larger pulleys, not less than 16 to 20 feet.

With main belts from engine to shafting, not less than 30 to 40 feet.

Very long distances between centers should be avoided.

Another rule for the distance between pulley centers is that it should be at least three times the diameter of the larger pulley and preferably four times.

Belts for the most satisfactory working should be nearly horizontal. If the design of the station places the generators and driving pulleys at different levels, the angle which the belt makes with the floor should preferably not exceed 45 degrees, but when the generators are placed in an upper story it is sometimes necessary to make this angle much greater. If it equals or exceeds 60 degrees, the generators should be placed on screws or carriages of some form, by means of which they can be raised vertically in order to tighten the belts.

In all places where the location of the belts makes it dangerous to pass around them, they should be enclosed within a railing.

All belts should be made endless.

The smooth or hair side of a leather belt should always be run against the face of the pulley.

In relation to width of belts, it will be found that the narrow thick belts give better satisfaction than very wide, thin ones. On a pulley 16 inches in diameter or larger it will be safe to use a double belt, and on a pulles 36 inches in diameter or larger a triple belt can be used. The pulley should be a little wider than the belt it carries.

Rope Driving.—In many cases it will be found desirable to connect the engines and generators by some form of rope transmission. This method of driving the generators has long been in use in Europe and is rapidly gaining in favor in America. It has the advantage of being noiseless, and is applicable to large powers. The wear on the rope is small; it requires much smaller pulley face to transmit the same power as a given belt, and the first cost of the rope itself is much less than that of a belt of equal capacity.

The most common materials of which the rope is made are cotton, manilla and hemp. It is possible to make rope out of wire and also rawhide, but neither of these materials is adapted for dynamo driving—the first on account of its lack of flexibility and the second because of its cost.

Cotton rope is superior to manilla in some respects. It is made of a softer fiber and therefore is more flexible and can be run over much smaller pulleys. Owing to the finer fiber, also, the internal wear on the cotton rope will be much less, while its lack of elasticity prevents its stretching. Cotton ropes are used largely in Europe, but they have one disadvantage in that they are not as strong as manilla ropes. In this country the use of manilla rope preponderates.

Manilla rope for power station work should be especially made of the longest and best fiber. The disadvantage of internal wear due to the grinding of the fibers over one another is overcome to a great extent by laying the fibers up in tallow and sometimes graphite. The best manilla rope for generator driving is made with tallow only, and it is customary with the manufacturers of such ropes to provide it with a colored strand running through its entire length, to distinguish it from other rope not especially made for transmission work. The rope below 1¼ inches in diameter is made of three strands and above that of four.

The grip upon the pulleys is obtained by allowing the ropes to run in V-shaped grooves. The angle between the binding faces of the groove is almost universally 45 degrees. An angle much greater than this would reduce the wedging action, while an angle much less would increase the wedging effect seriously and prevent the free release of the rope. A clearance space is always allowed at the bottom of the groove. The sides of the grooves are sometimes straight, sometimes curved. Two forms adopted by leading manufacturers are shown in Fig. 37.

FIG. 37. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—TYPES OF PULLEY GROOVES FOR ROPE DRIVING.

There are two general methods of rope driving which may be used to connect the engine fly-wheel with the driven pulley. These methods are known as the European and American, although both are used in this country. In the European method a number of independent ropes are used, while the other system requires only one continuous rope, which is wound about the pulleys a number of turns and then brought back to the first groove by means of slanting idle pulleys. Advantage is taken of these idle pulleys to tighten the rope. One of the idlers is mounted upon a sliding truck which is moved by a weight in such a way as to introduce a

tension upon the loose side of the rope, and thus act as a tightener. The European method has the advantage of doing away with the clumsy method of tighteners necessary with the other system, but on the other hand it is almost impossible to splice all the ropes on a pulley so that they hang equally, and the result is a number of ropes sagging differently, which presents a very disorderly appearance. The European method is thought to be safer from the fact that if one rope should break the remainder would carry the load until the repairs could be made, but as a rope will show signs of wear long before it is liable to give way, there is little likelihood that the American method will be found undesirable on the ground of danger of breaking, if it is properly installed and provided with sufficient strands of rope to do the required work.

In considering the length and size of rope to transmit a given horse power, care should be taken to figure on the safe side. The rope is subject to much wear and

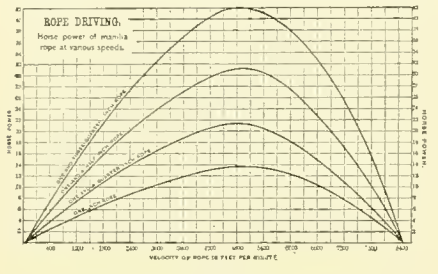

FIG. 38. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM FOR ROPE DRIVING.

tear, and to prevent frequent renewals a much stronger rope must be purchased than would be necessary for the installation if the rope always retained its initial strength. Fig. 38 shows a set of curves prepared by Mr. C. W. Hunt, which have been widely used. It is based upon the assumption that a rope one inch in diameter should have a working strain of 200 pounds at all speeds. The curves show the effect of centrifugal force upon the driving power of a rope and give a speed of about 4,800 feet as the most economical velocity. Above this speed the centrifugal force reduces the useful working power of the rope, and at 8,400 feet per minute the centrifugal force is equal to the safe strain on the rope, and no power can be transmitted. A set of curves very similar has been prepared by Prof. J. J. Flather, in which the economical velocity is shown to be 5,300 feet instead of 4,800. However, this makes but little difference in the result. It is possible to use smaller ropes for the transmission of a given horse power than given by these curves, but these values

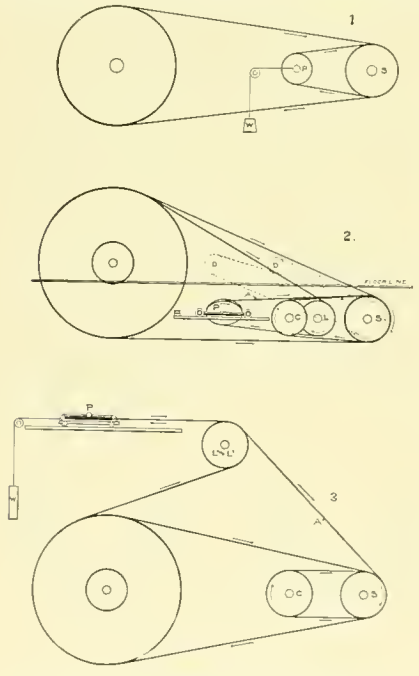

FIG. 39. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—ARRANGEMENT OF ROPE DRIVES.

are certainly safe ones. The effect of centrifugal force upon the driving power of ropes is not found to be practically what it is theoretically, and can be overcome to a small extent by extra weights; but the speeds usually adopted are between 2,500 and 4,500 feet per minute.

The American system lends itself to a number of arrangements, some of which are shown in Fig. 39. The simplest arrangement is shown by the first diagram, in which the rope passes spirally around the fly-wheel and shaft or dynamo pulley *S* a sufficient number of times to transmit the desired power, and then passes around the slanting pulley *P* and back to the starting point. The tension pulley *P* is mounted upon a movable carriage, and by means of the weight *W* keeps a constant tension on the rope. A more complicated arrangement is shown in diagram 2. This figure shows the compound winding of the American system. In this winding the loss of friction due to the small arc of contact on the driven pulley *S* is compensated by wrapping the rope a number of times about an auxiliary sheave *C*, which allows the use of a narrower driving pulley if it is considerably larger in diameter than the driven pulley. The course of the rope may be easily followed. Starting at point *A* the rope passes a number of times about the shaft pulley *S* and the rewinder *C* at the driven end, then a number of times about the fly-wheel and pulley *S*, finally passing to the idler pulley *L*, thence about slanting pulley *P* on the tension carriage and back to the starting point. The dynamo pulleys driven by means of belts from the main shaft are shown at *D D'*. It will be seen that this arrangement places all the sheaves and the traveling tension carriage below the floor line, which will add much to the appearance of the dynamo room. Another arrangement of the American system, which allows the tension carriage to be placed near the ceiling, is shown in diagram 3. Here the rope, starting at *A*, passes a number of times about pulleys *S* and *C* and a number of turns about the fly-wheel and shaft pulley, as before, and then finally about pulley *L* to the tension pulley *P*, from which it passes over pulley *L'*, which is parallel to *L*, back to the starting point. This arrangement leaves the basement free for foundations, but makes it impossible to use an overhead traveling crane. Numerous other arrangements are possible, and by proper design it is practicable to place the tension pulley in almost any place desired.

Practical Hints in Relation to Rope Drives.—In planning a rope transmission the following things should be known:

The diameters of the sheaves should always be as large as convenient. A good rule is to make the diameter 40 times the diameter of the rope, while 30 times should be the minimum size.

The tension carriage should adjust itself automatically to the proper inclination to take and give off the rope smoothly.

The ropes leading to the tension pulley should always be taken from the slack side of the drive.

It is preferable to use a large rope and a small number of turns rather than a greater number of turns of a comparatively smaller rope.

Advantages and Disadvantages of Belted Connection.—The advantages to be derived by driving the generators by means of belts or ropes are obvious:

First — Perfect insulation, as the engine and dynamo are entirely separated and only connected by a belt of insulating material.

Second — Flexibility, as a generator running at any speed can easily be accommodated on the line shaft. Space is the only requirement necessary to lay out a power station with countershafting, no matter what the type or number of the generators may be.

Third — Economy in first cost. The higher speeds at which the generators can be operated make their cost somewhat less and at the same time allow the selection of a lesser number of slow-speed four-valve engines than would be required for direct coupling, resulting in better fuel economy, especially in plants operating arc lights.

The claim is sometimes made that the belting plan has a further advantage, because in case of a short-circuit the slipping of the belt will relieve the engine of a sudden shock. With a weak engine this would be an advantage, of course, but a modern power station engine should be built equally as strong as the generator which it drives and should be fully as capable of withstanding fluctuations.

But, on the other hand, a number of very pertinent objections can be offered to the belting plan. It is liable to be unsteady in its action, which may become a decided disadvantage in the case of a lighting load, where the slightest fluctuation is to be avoided. Belts make more or less noise and are always unsightly in appearance. Furthermore, a belted plant always requires a large amount of floor space for a given output, and this is probably the main reason why this method of connecting the engines and generators has, as a rule, during the past few years, fallen into disfavor among power station engineers.

Direct Connection.—This is by far the most popular plan at the present time, and has many advantages. For very large units it has become to be considered almost imperative to directly connect the generator to the engine. The advantages of such an arrangement are:

1. Compactness. The amount of floor space required for a direct-connected unit may be as little as one-fifth the floor space taken by a belted unit of the same output.

2. Convenience. All the revolving parts of the generating plant are brought together, and in this way supervision is much easier.

3. Appearance. No unsightly belts or countershafting are required, and the engine room presents a clean, neat appearance.

4. Noiseless operation. The direct-connected unit makes little if any noise.

5. Absence of danger. Owing to the absence of belts and complicated countershafting, the plant becomes much safer to operate.

6. High efficiency. This is especially true of larger units. The direct-connected unit can be installed in much larger sizes than the belted or rope-driven unit, and one direct-connected generator may therefore be made to do the work of several smaller belt-driven dynamos, resulting in an increase in economy.

One disadvantage of the direct-connected method is the matter of extra first cost. This is the result of the necessarily low rotative speed of the steam engine. It has been pointed out that engines known as "high-speed" engines run at a maximum of about 350 revolutions per minute, while the larger sized Corliss type turn but 80 to 125 times per minute. To drive a generator with such a prime mover it becomes necessary to reduce the speed of the dynamo from a possible 1,000 revolutions to that of the engine. Now the output of an electrical generator depends upon three factors—the number of conductors on the armature, the number of turns per minute and the magnetic flux or number of lines of force. If the turns per minute are reduced, it becomes necessary to increase the other two factors a proportional amount, or the capacity will be reduced. This condition dictates a large number of armature conductors, and therefore an armature of large diameter and an increase in the number of pole-pieces, resulting in the multipolar dynamo. These changes mean that the size of a direct-driven generator will be much larger than that of a belt-driven dynamo of the same capacity. In fact, the extra cost will be between 25 and 40 per cent., depending on the size. But when the expense of the floor space, the cumbersome belts, belt tightener, countershafting and clutches is added to the belt-driven unit, the difference in actual cost, when ready for operation, is considerably reduced, and may even in some cases be in favor of direct connection.

Another disadvantage of a direct-connected plant is the lack of flexibility. If a generator becomes disabled

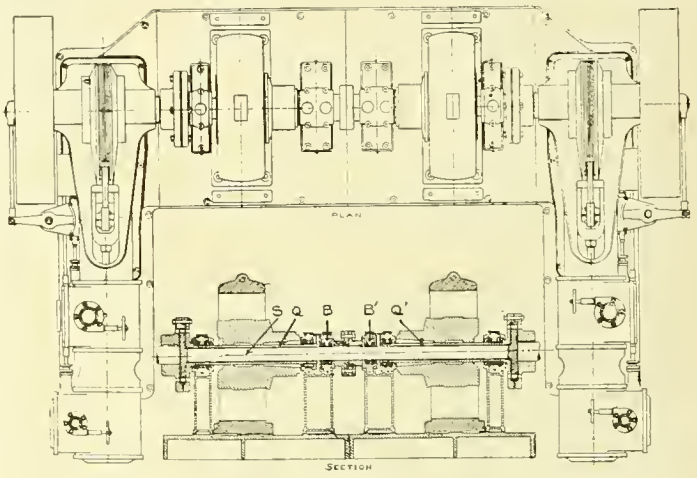

FIG. 40. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—PLAN AND SECTION OF ENGINE AND DYNAMO CONNECTION, CHICAGO BOARD OF TRADE PLANT.

it becomes necessary to shut down its connecting engine, which is not the case in a belt-driven plant. This necessitates a larger investment in reserve machinery, as an engine and generator must always be kept idle to throw in on the load in case of accident.

There are several methods of directly connecting the dynamo armature to the shaft. The armature can be mounted directly on the end of the shaft without an outboard bearing; it can be placed on an extension of the shaft, the end of which is carried in an outboard bearing, or the dynamo can have two independent bearings of its own, as in a regular belted machine, and be connected to the engine by some form of coupling. When an outboard is used, this bearing and pedestal and the cast-iron bed-plate upon which the dynamo is carried are furnished, as a rule, by the engine builder.

The type of engine to be selected for a direct-connected unit is an important consideration. For small units, such as would be used in an isolated lighting plant, for instance, the single-valve automatic engine is adapted, but for engines above 300 horse power, such as are ordinarily required in power-station work, the single-valve type should not be considered, on account of its lack of economy. All the considerations of durability and reliability in service and economy in operation point to the selection of the low or medium-speed four-valve engine. When real estate is valuable, or when from any other cause a compact plant is desired, the vertical marine type engine may well be used. This engine should have, preferably, a governor of the shaft type controlling both the admission and exhaust of the steam and should regulate within a range of two to three per cent. Where floor space is not so valuable the horizontal type of four-valve engine may be installed, and on account of its slow speed and good economy this type should give good satisfaction. The only possible objection to be urged against it is possibly the point of poor regulation, which is a result of its slow rotative speed, and this is especially pertinent in railway work, where the fluctuations of the load are frequent and sudden. Engines for direct-connected work should be built substantially, to withstand the shocks due to overloading or possible short-circuits. To meet the demands

for this class of work most builders have developed a type of engine built especially for this service.

The advantages and disadvantages of the belted and direct-connected plans have been discussed and it has been shown that to secure reliability with direct-connected generators an extra unit must always be held in reserve, while in a belted plant the large amount of floor space, the numerous belts, pulleys and shafts and the disorderly appearance rather offset the advantages of flexibility and reliability.

Quill System.—The power-station system which, for the present purpose, may be termed the "quill" system is thought to obviate the disadvantages, and at the same time combine the advantages, of both the belted and direct-connected systems.

A fair understanding of the principle underlying it may be obtained by referring to Fig. 40, which represents the plan and cross-section of the Chicago Board of Trade plant, consisting of two engines and two generators. It will be seen that the armatures of the generators are mounted upon hollow shafts or quills *Q*, which are supported by independent bearings. Through these quills, but not in contact with them, extends an auxiliary shaft *S*, which is also carried upon independent bearings *B B'*. This shaft is concentric with the engine shafts, but is independent of them, and when the plant is operating under normal conditions does not revolve but lies passive in bearings *B B'*, ready to be brought into service when needed. The couplings shown are so arranged that any generator can be connected at will, by means of bolted or magnetic couplings, either to the flange of its adjacent engine or to the auxiliary shaft. In this way each generator is available from two engines. In normal operation each engine drives its adjacent generator directly coupled without revolving any more shafting than is usual with ordinary independent unit direct-coupled plants, but in case of accident, either generator, or both of them, if necessary, can be reached by either engine. The left-hand generator can be operated by the right-hand engine without revolving the armature of the right-hand generator, or *vice versa*, leaving the other engine and dynamo idle for such repairs as may be necessary. By using compound engines designed for the possible working of high-pressure steam in the low-pressure cylinder, one engine can be made to double its power for a few hours. The plant has thus the total generator capacity available at all times, and allows one engine to be in reserve in case repairs are necessary.

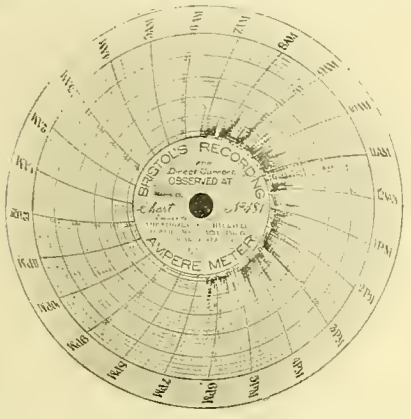

FIG. 1. AN INCIDENT IN CENTRAL STATION PRACTICE.

This system of mounting the armatures upon hollow shafts through which extend an auxiliary solid shaft to which each generator may be connected or disconnected at will may be extended to a plant containing any number of generators. It will thus be seen that without resorting to the use of the ordinary line shaft, with its belts and pulleys, the flexibility of a belted plant has been secured, while at the same time there has been retained all the compactness, convenience and neat appearance of the direct-connected arrangement.

Fig. 41 represents the 1,000 horse power plant now being installed for the Englewood & Chicago Electric Street Railway company under this system. In this plant it is desirable to operate three generators at different voltages all the time. The center engine is of 500 horse power capacity, and when running under normal conditions operates the two middle generators direct-coupled, while either end engine can drive its adjacent generator exactly as in a regular direct-coupled plant, without revolving any auxiliary shafting. But in case anything should happen to any engine or generator it is possible, by means of the interior shafts, to run all four generators from the center engine, or two from each outside engine. The entire engine and dynamo plant occupies a space only 12 feet wide by 55 feet long. By this arrangement, with three engines, a plant is secured having the same reliability as a plant containing four engines, and it occupies considerably less floor space.

The advantages of this system when applied to still larger plants become greater, for by its use the amount of engine power usually placed in several small engines can be combined into two or more large engines, resulting in a lower first cost for engines and the same reliability in service.

["Generators and Switchboard" come next in the series.]

Proposed Protection for a Niagara Industry.

In the United States Senate on May 27th Senator Aldrich offered a committee amendment to increase the duty on chlorate of potash from two to 2½ cents. This was resisted by Mr. Vest, who said the article was required in manufacturing cotton goods, and who made a general plea about taxing raw materials. Mr. Platt of Connecticut pointed out that the change was designed to free the United States from dependence on the united alkali trust of England, and to encourage an American industry which is about to utilize the power of Niagara Falls, meaning the Mathieson Alkali company and probably the Chemical Construction company.

"I am too much of an American," remarked Mr. Vest, "to think that Niagara Falls needs any protection against competition from foreign producers."

Mr. Gallinger stated that this started a new American industry just as protection had started the tin plate industry.

"You can build up anything if you only give subsidy enough," declared Mr. Gray. "You can grow oranges under glass in New Hampshire."

The Aldrich amendment increasing the rate on chlorate of potassium to 2½ cents was agreed to by a vote of 33 to 27.

Responsibility of Telegraph Companies for Errors.

How many times will the courts be called upon to decide the responsibility of telegraph companies for damages resulting from the imperfect or delayed transmission of telegrams? asks the *Chicago Chronicle*. It seems as though the dockets always held some such suits. The companies fall back upon their arbitrary conditions of sending, printed upon the back of their blanks, but these have long since been decided to be no excuse for either mis-sending or delay. A telegram sent from a Boston packing-house one day ordering its agent not to buy hogs was not delivered till the next day, after he had purchased several carloads. The telegraph company held that its liability was limited to the price of the message, but the Appellate Court very properly decided that this is not the law. Nor would the repetition demanded by the "conditions" have tended to prevent the mistake or to protect the company from damages. There is nothing in the law which exempts a telegraph company from damages arising from the mistakes of its employes any more than any other private corporation.

The Electro-visual Telegraph company of New York city has been incorporated with a capital stock of $50,000. The directors are Martin C. Ebel, Florence S. Pierson, George L. Mason and Carroll Sprigg of New York city, and Robert M. G. Welford of Hackensack, N. J.

An Incident in Central Station Practice.

By Orrin E. Dunlap.

Electricians in and about Niagara Falls recently had their attention called to the effective workings of a governor made by the Lombard Water Wheel Governor company of Boston, Mass., and which was doing service in the new power station of the Niagara Falls Hydraulic Power & Manufacturing company, located at the water's edge below the high bank. This governor was attached to a 2,000 horse power turbine made by the James Leffel & Co. of Springfield, Ohio, to which in turn was direct-connected two General Electric company's 750 horse power 500 volt generators.

The incident which served to portray the efficiency of the turbine, generator and governor, when so installed, occurred on the morning of March 17th. At that time the erection of the new steel arch bridge across the Niagara gorge was going on, and between 11 A. M. and 12 M. of that day the workmen dropped a heavy piece of the steel frame of the bridge, and it fell across the trolley line of the gorge road, which passes beneath the structure. The effect was to create a dead short-circuit, which existed for over half an hour. The amperemeter chart in use at that time and herewith illustrated (Fig. 1) shows the load of the day and the point when the short-circuit occurred. It will be noticed that the recording pen ran way out to the edge of the card. The voltmeter chart, also presented herewith (Fig. 2), shows how steady the voltage was maintained on the day in question, and especially between the hours of 11 and 12, when the short-circuit occurred. It will be noticed that the shading of the line between 11 A. M. and 12 M. is but little heavier than the recording line of the entire day. Electrical Superintendent Frank G. Lott is delighted with the record the installation made on the day when the short-circuit occurred, and takes pleasure in showing the charts.

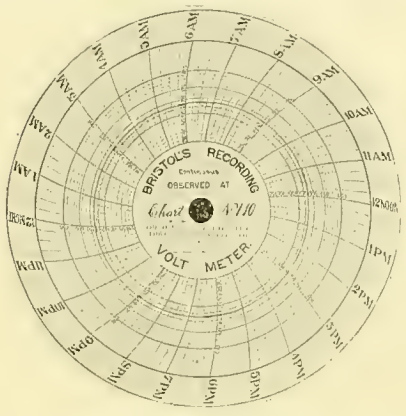

FIG. 2. AN INCIDENT IN CENTRAL STATION PRACTICE.

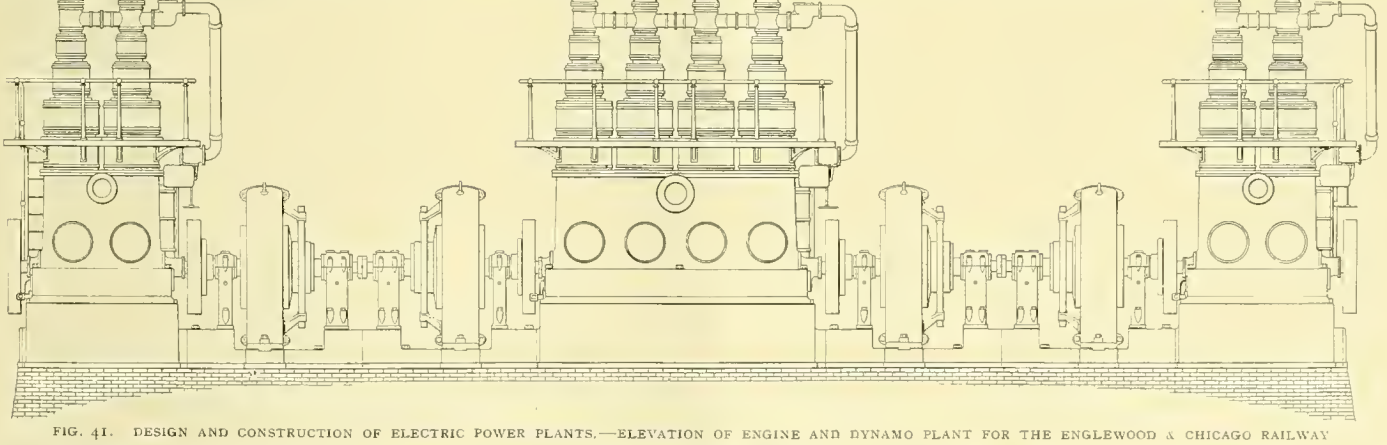

FIG. 41. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—ELEVATION OF ENGINE AND DYNAMO PLANT FOR THE ENGLEWOOD & CHICAGO RAILWAY

Judges differ as to the admissibility of sciagraphs in evidence in lawsuits. In one of the latest cases Judge Hutchinson of Chicago has decided adversely. Carl Lampke sued the Gloss Printing company for $10,000 for injuries received while an employe of the company. His leg was crushed just above the ankle. His attorneys produced X-ray pictures of the injured limb, showing how the bones had been broken. Judge Hutchinson held that the pictures were not admissible. The court said that a sufficient foundation had not been laid for their introduction.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE WESTERN ELECTRICIAN arises to ask a question. Did a certain incandescent lamp concern (in the pool) sell to an establishment in Wabash avenue, Chicago, 10,000 incandescent lamps at a contract price of 20 cents each, and then deliver sufficient lamps over and above the 10,000 to make the actual net price of all the lamps delivered 13 cents each?

SOME of the incidents attending the introduction of the telephone in this part of the country are related in a contribution on "Mr. Beach and the Telephone Industry in the West," from the pen of W. S. Chapman, secretary of the Central Union Telephone company, who was associated with Mr. Beach for many years. These reminiscences are amusing now, but at the time referred to the incidents mentioned were doubtless very serious conditions. The attitude of the general public toward the telephone at that time made it necessary, as Mr. Chapman says, "to appeal to selfishness, envy and pride" to secure the introduction of the telephone into general commercial use.

THE meeting of the National Electric Light association at Niagara Falls will be an event of uncommon interest. The attractions for those who are studying the problems of the development and transmission of power will prove great, no doubt, and, owing to the season of the year, it is reasonable to expect a very large attendance.

The WESTERN ELECTRICIAN will signalize the event by issuing a special convention number, which, it is needless to say, will form not the least important feature of the occasion. It will contain many special articles prepared for this event and having a direct bearing upon the work for which the members will assemble. They will be profusely illustrated, so that the artistic and mechanical features will be in keeping with the general standard of excellence established and maintained by this journal. It might be considered superfluous to mention these matters, were it not for the fact that unusual efforts have been put forth to make this number surpass all former attempts in this line.

THIS is the week of the convention of the Canadian Electrical association, and the representatives of all departments of electrical activity in the Dominion are gathered at Niagara Falls for entertainment and instruction. They will visit the American side, and study the progress that has been made in the development, transmission and utilization of power as exemplified in the great power generating plants, and the industries consuming the electrical energy there produced. Our Canadian friends are looking forward anxiously to the time when the power of the Niagara will be utilized in like manner on their side of the river. In this connection the report of the commissioners upon the subject of the contract with the power company and the proposed extension of time which it is now expected will be reconsidered and approved, will be of especial interest to the Canadian association.

There are, of course, many other features of interest to be considered at this meeting, which, by the way, presents a striking illustration of the advancement that has been made by our neighbors in the last few years.

THERE is danger that the recent action of Judge Hutchinson of Chicago in excluding sciagraphs from evidence in a case for damages which was tried before him last week may be misunderstood or misinterpreted. The action was brought by Carl Lampke against the Gloss Printing company for $10,000 damages for injuries he received while an employe of the company. His leg was crushed just above the ankle by a piece of machinery. Munson Case and W. S. Johnson, his attorneys, produced sciagraphs of the injured limb showing how the bones had been broken. The defendant objected to the introduction of these pictures as evidence. The plaintiff produced three rulings by the Supreme Courts of Colorado, Pennsylvania and New Jersey in which it was held that such pictures were competent evidence. Judge Hutchinson admitted that sciagraphs were proper evidence, but he held that the plaintiff had not established sufficient foundation to warrant the admission of those offered in the present case. As the attorneys for the plaintiff did not consider the pictures of vital importance to this case, they did not press the matter. It will be of interest to the electrical and surgical fraternities, however, to know that Judge Hutchinson's ruling was not against the introduction of sciagraphs. On the contrary he declared that they were competent evidence, but he appeared to be under the impression that the X-ray was not sufficiently recognized by the medical authorities to warrant the introduction of sciagraphs without first establishing special foundation for their admission.

In striking contrast to the action of Judge Hutchinson in this matter is the policy of the lower courts of New York state, as shown by the account of a trial at Lockport, where sciagraphs played an important part in winning the largest verdict for damages ever awarded by a jury in Niagara county. The details are related by Mr. Dunlap on another page of this issue. The facts there presented are but an indication of the general public opinion upon the reliability of sciagraphs. In the light of these facts it would seem that the admission of evidence of this character should not be further questioned by the courts in Cook County, Illinois.

COMMENTING upon the interest manifested in the controversy over the street railway bills in the Illinois Legislature, a financial writer declares that special legislation affecting street railway property has been prompted in several states by this conflict. Generally speaking it may be said that these bills in legislatures and city councils tend toward a more rigid regulation of these corporations, and some of the measures are quite impracticable. It is explained that, although the introduction of electricity as a motive power is immeasurably beneficial in many important respects, it has been in innumerable instances productive of immense financial losses to investors who paid inflated prices for securities, and that this has tended to arouse bitterness against street car lines. During the first period of street railway construction in America, extending from 1850 to 1870, motive power was supplied by horses. Then followed the introduction of the cable, which, however, in addition to various material defects, was found to be too expensive to operate outside the large cities. Next came electricity, and this method of propulsion appears, for the time at least, to have, to a great extent, revolutionized the system physically and financially. Not the least important of the changes effected by the introduction of electricity is the transformation in the character of the securities. Whereas, in the early days of street railways they were purely local enterprises, it has now become common for electric lines to be owned in communities hundreds or thousands of miles distant from their field of operations; and, therefore, the interest in street car concerns has become national. Not only is new legislation being everywhere agitated, but ancient and forgotten laws and ordinances are being resurrected with possibilities of vast import to everybody having interest in street railway systems.

IT would seem as if the subject of the magnetic concentration of ores would continue to occupy attention indefinitely, even though little practical advancement be made. Much speculation is indulged in whenever any departure from or improvement upon present methods is suggested. A recent paper before the Franklin Institute is attracting attention at this time. The chief feature of the Wetherill process, which is there described and discussed, is the employment of a magnetic field of such intensity, and concentrated in a place where the crushed mineral must pass, that sufficient attraction will be exerted upon substances that are almost non-magnetic to deviate their motion away from that of the general mass. The mineral particles are then caught upon a belt conveyor that moves in the air-gap between the magnet poles producing the field, and are conveyed away, while the non-magnetic earthy matter and other impurities are carried off by another belt or allowed to drop. The results of some experiments are recorded, but the actual field strengths do not appear to have been measured. It was announced in the discussion that for the last three or four years a magnetic process had been in use in Finland for the concentration of copper and zinc ores. In this instance an artificial magnetic property is imparted to the mineral by special roasting, which converts the small quantity of iron pyrites into magnetic pyrrhotite. Doubtless concentration is effected in this way, but, on the other hand, no assurance can be given that a portion of useful mineral is not lost in the tailings, since there may be some proportion of the mineral not rendered artificially magnetic by the presence of roasted pyrites. Comparison is instituted with the Wetherill process, for which it is claimed that special roasting would be unnecessary. The objection is raised that, although the magnetic field might be strong enough to separate pyritic mineral after the ordinary dead roast, and without special "magnetic" roasting, yet it is scarcely probable that all the particles of crushed mineral would be associated with pyrites, or, at any rate, with sufficient of them to lift them on to the conveyor. The result of all of these investigations, therefore, is that magnetic separation is only applicable with certainty to minerals which are intrinsically sufficiently magnetic in character to be sifted out by the magnetic field, which cannot be said to be an advancement upon the conclusions of those who studied the question years ago.

Louis A. Ferguson Appointed General Superintendent of the Chicago Edison Company.

Louis A. Ferguson has been appointed general superintendent of the Chicago Edison company, and on June 1st he assumed the duties of his new position. Mr. Ferguson is an experienced central station man and is recognized as an authority on all matters pertaining to the construction and operation of plants of this character. He is especially familiar with the Chicago Edison company's plant and the conditions and requirements of that corporation's service, as he has been associated with the enterprise through all the several stages of development and expansion that marked the period between the building of the Adams street station and the present comprehensive system. Mr. Ferguson is well equipped for this work by education and experience, as he has made electrical engineering his chief study and has enjoyed many advantages for original and experimental work.

Born on August 19, 1867, at Dorchester, Mass., now a suburb of Boston, he was educated in the Boston public schools, graduating from Dorchester High School in 1884. He then entered the Massachusetts Institute of Technology and was graduated from that institution in May, 1888, with the degree of Bachelor of Science in the department of electrical engineering. His thesis work at the Technology Institute consisted in original experiments to determine "the law of relation between candle power and current, voltage and energy consumed in incandescent lamps."

His work at the Institute of Technology attracted favorable attention and he was offered a position with the Chicago Edison company in July, 1888. Shortly afterward he became electrician of the underground department. In 1889 he was made assistant electrical engineer in the construction department and in 1890 was appointed electrical engineer of the company. In 1893 he was given charge of the contracting side of the company's business in addition to the electrical engineering and construction work and has had charge of these departments under the title of electrical engineer. As general superintendent Mr. Ferguson will have charge of the operating and electrical engineering departments, as well as the central station and isolated plant business, reporting to the president of the company. Mr. Ferguson was one of the staff of lecturers of the University of Wisconsin in 1895, and delivered a lecture on "Electrical Engineering in Modern Central Stations," which has since been published by the university. He also read a paper at the last meeting of the National Electric Light association at New York on "The Commercial Value of Acetylene Gas as an Illuminant," giving the results of his experiments made with Messrs. Wilson and Knapp at Spray, N. C., in May, 1895, in the production of calcium carbide and acetylene gas. This paper was published in pamphlet form by order of the National Electric Light association.

Mr. Ferguson was one of the charter members of the Technical club of Chicago and he is also a member of the Country club of Evanston and the Evanston club. Socially and professionally Mr. Ferguson commands the respect and esteem of his associates, and they will all be exceedingly pleased to learn of his well-deserved promotion.

National Electric Light Association.

Secretary Porter announces a change in the programme of the Niagara convention, published last week. Mr. Stillwell's lecture, he says, will be delivered in the park pavilion on the evening of Wednesday, June 9th, instead of at the Lyceum Theater. The pavilion is located in the park of the New York State reservation, and is near both the International Hotel and Cataract House.

From the amount of correspondence being received from central station managers, the officers of the association believe a most unusual interest is being taken all over the country in the coming meeting. Several new members were added to both active and associate list during the last week. On the same authority it is announced that the representation from central stations will undoubtedly be larger at the Niagara meeting than at any convention of recent years, and the number of associate members will equal the usual number.

On Thursday, June 17th, the fifty-third annual commencement exercises of the University of Notre Dame, Ind., will be held. The event will be celebrated with unusual ceremonies this year. The institution is in excellent condition and the class of this year is one of the best that has yet been turned out.

Mr. Beach and the Telephone Industry in the West.

By W. S. Chapman.

It has been suggested that I write something in the way of a reminiscence of the telephonic career of the lamented Franklin G Beach, since it was my good fortune to be associated with him almost from the inception of the telephone business in this part of the country.

For nearly eighteen years my business and social relations with him were of the most intimate, cordial and agreeable character; hence, in reviewing the past, my heart swells with emotion at the thought that he has gone from among us forever.

It was in the latter part of 1879 that our acquaintance was formed. He was then the special agent of the Western Union Telegraph company, in charge of its telephone business in the Illinois-Iowa district, while I had just been appointed chief clerk in the office of the general superintendent of the same company. We had adjoining offices on the third floor of the old Union building, the site of the present Chicago Stock Exchange.

Mr. Beach's clerical force consisted of one general clerk and an office boy, and yet such was his indomitable energy and expeditious methods that he supervised all records and expenditures, conducted a heavy correspondence, drafted contracts and a variety of miscellaneous documents, and generally scrutinized everything for which he was responsible. Much of his correspondence was "blocked out" as he traveled by rail from place to place, and sent to his clerk for transcribing and posting. He seldom spent to exceed two days of the week in his office, the remainder being fully occupied in traveling, superintending the installation of exchanges, procuring ordinances and rights of way, canvassing for subscribers or cultivating the good will and influence of newspapers and leading citizens.

"F. G.," as he was familiarly known, was without a peer in making a preliminary canvass for an exchange. In that early day the telephone was generally considered a useless toy, and, of course, its introduction into practical use was fraught with many difficulties. To convince the people, by oral argument, of its utility and convenience required more time than could be spared, hence a more expeditious and effective means had to be devised. "F. G." was equal to the emergency Through the press he announced his mission, then, in company with the mayor, or other influential citizen, he would call upon a few of the leading business men and manufacturers of the town, and, after exchanging the usual courtesies, he would present his card with a promise to call again to discuss the business in hand. If, upon his return call, he found Mr. Smith disinclined to subscribe, a pleasant "good-day" ended the interview, and, repairing to the office of Mr. Brown, Smith's wide-awake and progressive competitor, a few words sufficed to convince him that a telephone would be just the thing to divert some of Smith's trade. The order was given. Subsequently Smith was compelled to have a telephone also to protect himself.

In like manner initial residence connections were secured by playing upon the personal pride and envy of aristocratic housewives. Mrs. Jones could not tolerate the thought of her neighbors having more or nicer things than she; therefore, when it was casually intimated that Mrs. Martin was to have a telephone in her residence, all prejudice against the "useless toy" vanished and Mrs. Jones' order was given, accompanied by the urgent request that hers be put in first and "right away." Thus, by appeal to selfishness, envy and pride, was solved the most difficult problem then confronting the telephone business.

With the absorption of the telephone interests of the Western Union company by the American Bell, "F. G." was at once appointed superintendent and given charge of the business of the licensees of the latter company.

The growth and development of the business in every direction required a very high order of electrical skill and executive ability, both of which Mr. Beach developed with remarkable rapidity. His genius produced many devices and methods of simplifying, improving and popularizing the service, and his ideas were ever in advance of the actual development of the art.

In April, 1881, he was appointed general superintendent of the Western and Central Telephone companies, whose territory comprised, in most part, the area of Illinois, Iowa and Indiana.

In May, 1882, his jurisdiction and authority were extended to the territory of the Midland Telephone company in the state of Ohio.

In November, 1894, he was appointed general manager of the Central Union Telephone company, which position he held at the time of his death. Thus, step by step, this conscientious and untiring worker, upright and honored official, generous and warm-hearted friend, advanced upon his merits from the special agent of 1879 to the position of general manager in 1894-7, at which latter date he "rested from his labors;" but the recollection of his many virtues, the benignity and generosity of his nature, remain to stimulate and uplift his grief-stricken friends and associates.

Preliminary Organization for a National Anti-Bell Telephone Association.

Responding to the call of James E. Keelyn of Chicago, a number of independent telephone men met in Chicago on Thursday and Friday of last week and perfected the organization of the nucleus of a national telephone organization having for its object mutual assistance against the patent claims and business methods of the American Bell Telephone company. A similar gathering was held in Fort Wayne, Ind., earlier in the week; and it is the earnest hope of all sincere and disinterested friends of the independent telephone movement that nothing shall be allowed to divide the forces of the opposition, and that a united front may be presented to the common enemy.

Mr. Keelyn acted as chairman at the opening sessions of the Chicago meeting, being later succeeded by Judge J. M. Thomas of Chillicothe, Ohio, the president of the Ohio Telephone association. W. J. Vesey of Fort Wayne, Ind., was the secretary of the meeting. At the first session, after some preliminary discussion, the project in hand was referred to an executive or organization committee consisting of T. A. Marshall, Keithsburg, Ill.; George W. Beers, Fort Wayne, Ind.; H. C. Young, Columbia, Pa; Angus Leek, Cairo, Ill.; J. L. Stone, Rushville, Ind; D. H. Gilbert, East Saginaw, Mich.; L. D. Robinson, Washington, Ia.; C. Truitt, Columbia, Mo; D. M. Burke, Carbondale, Ill., and S. T. Slade, Oskaloosa, Ia. This committee after deliberation, recommended that an executive or general committee be appointed, to consist of two gentlemen from each state, and that sub-committees, as required, be named from this general committee. This suggestion was adopted, and the following selection was made for the permanent committee:

Illinois.—T. A. Marshall, Keithsburg; Dr. I. A. Lumpkin, Mattoon.

Indiana.—Hugh Dougherty, Bluffton; J. L. Stone, Rushville.

Iowa.—S. T. Slade, Oskaloosa; A. T. Averill, Cedar Rapids.

Kansas.—W. C. Hewitt, Leavenworth.

Kentucky.—W. B. Seaton, Ashland; H. K. Cole, Owensboro.

Maryland.—Charles E. Fink, Westminster; Clarence Hodson, Baltimore.

Michigan.—W. H. Gilbert, Saginaw; D. McVichey, Ishpeming.

Minnesota.—William Hayes Laird, Winona.

Mississippi.—W. B. Stewart, Natchez; E. S. Crane, Yazoo City.

Missouri.—H. E. Ralston, Maryville; E. C. Baker, Cameron.

New Hampshire.—F. W. Story, Laconia.

New Jersey.—W. H. Rankin, Elizabeth.

New York.—D. C. Dow, Cobleskill; I. A. Evans, Rome.

North Carolina.—W. Newton Smith, Tarboro.

Ohio.—J. M. Thomas, Chillicothe; H. D. Critchfield, Mount Vernon.

Pennsylvania.—C. R. Savidge, Sunbury; H. C. Young, Columbia.

South Carolina.—R. B. Lebby, Charleston; J. H. Twichell, Spartansburg.

Tennessee.—L. P. Padgett, Columbia.

Texas.—L. C. Ketcham, Palestine; E. L. Bacon, Beaumont.

Vermont.—George H. Almon, Montpelier; C. L. Orbitt, Enosburg Falls.

Virginia.—W. P. Roberts, Lynchburg; S. A. Duvall, Richmond.

West Virginia.—H. E. Mathews, Huntington; J. M. Payne, Charleston.

Wisconsin.—William H. Lohmiller, La Crosse.

The provisional executive or organization committee also presented this report, in the shape of a resolution, which was adopted:

Resolved, That the executive committee, as now constituted and provided for, shall be continued until discharged at or after the meeting to be called for the formation of a national association as hereinafter provided; that said meeting shall be called to meet within 30 days from this date, the time and place of which to be fixed by this executive committee, the meeting to be called for such place as in the judgment of said committee shall secure the largest attendance; that steps be taken to notify every local exchange in the United States, together with the owners or operators of toll-line service of such meeting, with a request that it be represented

by at least one person authorized to act for and bind such exchange or toll-line company; that the call for said meeting shall be signed by the members of this executive committee, and in event there be present from any state a person interested as an operator of telephones, but who is not a member of this executive committee, and in the further event of such state having no executive committeemen, then the call to be also signed by any and all such persons not exceeding two from any such state; that said call shall not be signed by any person interested as a manufacturer or a vendor of telephonic apparatus or supplies; that said committee shall have power to fill vacancies should any exist or occur, and add to said committee by appointing or selecting not more than two members from any state not now represented on said committee, which, in the judgment of said committee, may be desirable; said committee to prepare a draft of a constitution and by-laws to be presented for adoption at the meeting hereinbefore provided to be called; that said committee also prepare a plan for the permanent organization of a national association at that time; that said committee report a plan and basis for a union of both the operators and users of telephones and telephonic apparatus and manufacturers thereof; that said committee issue a call to all the known manufacturers of opposition telephonic apparatus in the United States, asking them to meet at the time and place as the meeting of the operators hereinbefore provided for, and then and there to confer with reference to a union of the two interests.

In resigning as chairman of the temporary organization Mr. Keelyn said: "When this matter was first brought up, it was thought that for the purpose of a preliminary organization I best might act as chairman; that a call from me would be answered somewhat fully. In carrying out the line of that preliminary organization I may have engendered some bitterness; my motives may have been misconstrued. I trust that you may select someone now against whom no reflection of mercenary motives can be had. It will be my further duty to help this association, or this convention, to a successful end. I shall be glad to use what efforts I have in that direction, so long as I find that it is in the interests of the independent telephone movement, without regard to any class or phase."

Judge Thomas was then elected temporary president and also chairman of the executive committee. He is a prominent independent telephone man and president of the Home Telephone company of Chillicothe, Ohio, which is said to operate over 500 instruments.

A vote of thanks to Mr. Keelyn, moved by J. L. Stone of Rushville, Ind., was carried unanimously.

Adjournment was taken to Detroit, and the date of the next meeting was fixed for June 22d.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Muscoda & Oak Grove Telephone company has been incorporated at Muscoda, Wis., with $1,000 capital.

Some farmers in Yankton county, S. D., want the Northwestern Telephone Exchange company to pay at the rate of $250 per acre for a right of way for their poles. Condemnation proceedings will be begun.

The New Ulm Telephone company has been incorporated at New Ulm, Minn., to build to Mankato and Springfield, Minn.

The Home Telephone company of Fairfield, Iowa, after considering the effect of the Berliner decision, has decided to go ahead and construct its exchange.

The Boone County Telephone company is building a copper metallic line between Des Moines and Boone, Iowa.

George H. Stanton, who has applied for a telephone franchise in Great Falls, Mont., says he will begin work as soon as the franchise is granted.

The Western Electric Telephone company has applied for a franchise in Eau Claire, Wis.

E. E. Hess contemplates extending the telephone line from Wellman, Iowa, through Kalona and Richmond to Washington, Iowa.

Frank Lashway, manager of the Chippewa Falls, Wis., exchange of the Wisconsin Telephone company, has been promoted to take charge of the local exchange at Neenah, Wis.

Disadvantages of Telephone Sub-stations for Business Houses.

According to a Chicago newspaper, switchboards are making young heads at the telephone offices develop a sprinkling of gray hairs. The patient girls are joined in the complaint by people who smother their wrath in a long wait for their turn to call up central. One big mercantile house recently abandoned its dozen telephones and substituted a switch that would connect with every department. The telephone company was called upon to furnish the operator, and this contribution it has been forced to repeat every week. Women who have long held down the bench in the main office have been sent to the switch, but after a fruitless trial to overcome impatience have given away. People are naturally hasty when direct connection is had on the wire, but when it comes to being held back by someone who is just a second ahead of you on the switch, impatience cannot be brooked. These are some of the expressions of haste hurled at the girl who has the switch in her care:

"For heaven's sake, has that guy got a mortgage on the wire?"

"Cut them short and let me get in."

"This is most important, and I must have central first."

"Dog ghast this switchboard. Hustle up my number or there'll be trouble."

The employes say they will go on a strike in a hurry unless the old system of many telephones and more expense is given back to them.

Judge Taylor's Analysis of the Berliner Decision.

At the meeting of independent telephone men held in Fort Wayne last week to outline a plan of co-operative defense for the anti-Bell forces, Hon. R. S. Taylor, one of the government counsel in the suit attacking the issue of the Berliner patent, made an interesting address. From the account in the *Fort Wayne Morning Journal* this report is taken:

Judge Taylor said that the main ground upon which the suit was brought was decided against the government with a reasonable degree of directness and fairness, although the position of the government in the case was not stated in the opinion quite as distinctly as he could have wished. The main ground upon which the suit was brought was the delay of the Bell company for 13 years in taking out the patent—especially the last nine years of that time. It was not claimed by the government that the proofs showed any express fraud or corruption on the part of the Bell company, such as bribery of the Patent Office officials, misrepresentation of facts, or other acts of fraud of gross nature. In fact, the Bell company had very shrewdly contrived to appear to be desirous of having its patent issued, while it was carefully omitting to take very obvious steps by which it could have brought about that result. The Bell company from 1878 down was using the Blake transmitter under the protection of patents to Bell, Blake, Edison and others. It thus had a monopoly of the instrument under existing patents. At the same time it was carrying along an application which it had purchased from Berliner for a fundamental invention which would cut under Blake and Edison and all the others except Bell, and prolong the monopoly, if granted, for 17 years from the grant of the patent. It was contended by the government that a person thus holding a monopoly under existing patents and at the same time prosecuting an application for another patent which would prolong the monopoly owed a duty to the public to speed his application with all reasonable and practicable diligence. And the charge of the government was that the Bell company failed to discharge that duty; that instead of speeding its application it improved every opportunity of delay which did not throw upon it the direct and obvious responsibility therefor. Or, in the language of counsel for the government, quoted in the opinion:

"The guilty party is the Bell company. It had a full and perfect inside view of the situation from the beginning. Its attorneys were wiser in these things than the commissioners or the examiners. They shrewdly availed themselves of every unauthorized usage, mistaken assumption, ignorant misconception or supposed obstacle, by means of which the issue of the patent could be delayed without apparent responsibility on their part. In view of their duty which rested upon the company to speed the application, that was fraud, not less but more reprehensible because it was not of the common and gross kind, but so refined and acute that its garb of professed innocence has deceived even the Court of Appeals."

The Supreme Court found that no such duty existed; that the Bell company was under no obligation to take any step to stir the officials of the Patent Office to activity, or point out to them where they were in the wrong, or make any effort to correct any mistake into which they had fallen, notwithstanding they might be well aware that by refraining from these things they were laying upon the people the burden of a prolonged monopoly in the microphone. This point was fundamental, and this decision of it swept away the government's case so far as it related to the delay in issuing the patent. It was not for him to say that the decision was wrong, although he had held a different view. The question was entirely novel. No case involving it had ever been decided. It is important that courts shall go carefully over new ground, and perhaps the decision of the court was wiser than the contention of the counsel.

But the decision left untouched every question in regard to the validity of the Berliner patent, which was open to contest by the user of the microphone from the beginning. A person sued for infringement cannot set up as a defense that the application was unreasonably delayed in the office. So that the only question decided by the Supreme Court was one that a private individual could not raise. The suit, therefore, had been a great advantage to the independent telephone companies. It had kept the Bell company at bay for four years, during which time they had had time to enter the field, organize their companies, enlist the patronage of the public and get into condition to make a strong fight, and much stronger than they could have made four years ago, and with the advantage of every ground of defense which they could then have made.

On the subject of the validity of the patent, he said that there were four grounds upon which it could be assailed. The first was the grant of a patent in 1880 upon a division of the original Berliner application which contained a microphone transmitter described and covered in the patent of 1891, tried in the Supreme Court. He said he would not enter upon a detailed discussion of the technical questions involved in this defense, but would say that in his opinion it was a good one. It was decided to be a good one by the circuit judge in the government case, and the Circuit Court of Appeals made no decision upon the merits of the question; neither did the Supreme Court. The decision of the Circuit Court is the only decision which has been made on that question on it merits as against the patent. The question is debatable, and no one can undertake to say with certainty what the view of the court trying the case might be. It is a case in which a lawyer can do no more than give his own opinion.

The next most important defense rests upon the fact that the patent as granted is not for the same invention which was described in the original application. The original application contains a description, imperfectly stated, of the microphone, but it was also stated that it would not transmit speech. Another form of instrument was described and claimed. Subsequently the application was changed, and the instrument which it was declared in the first place would not transmit speech was brought forward as the main invention and covered by the claims.

This point also is open to some discussion. It is claimed by the company that, although the original application rejected the microphone as incapable of transmitting speech, it nevertheless described it in such a way as to authorize the applicant to retract his error and claim the microphone.

Another question relating to the patent is whether the microphone was first discovered by Berliner or Edison. It is certain that Mr. Edison produced the first successful microphone. He had it in use in the spring of 1878 before anybody ever transmitted speech through a Berliner microphone. But which of the two was the first to conceive the idea is a question which has never been judiciously investigated and which is in considerable doubt. The uncertainty attending it was so great that no proof on that subject was offered by the government in its suit.

Another question arises upon the scope of the claims. They cover every form of instrument having two electrodes in constant contact with a variable pressure between them caused by the vibrations of the diaphragm. There is no limitation in the claims as to the material or structure of the electrodes. They may be metallic, or of carbon, or anything else that will conduct electricity. It was made known by Bell in 1876 that a transmitter could be made by bringing an electrode of solid material into contact with a fluid, such as mercury or water. In fact, Mr. Bell's first transmission of speech was by means of such a transmitter. The question arises whether Mr. Berliner, by not limiting his claims so as to exclude liquid electrodes, has not made them so broad that they are invalid.

There are some other questions open to persons who may be sued for infringement, but these are the leading ones. None of these questions are decided by the Supreme Court. It expressly declined to decide any of them, upon the ground that they could not be contested by a private individual on his own account, and therefore did not properly belong to the suit by the government to set aside the patent. While the decision does not say so in express terms, it is to be implied from its language that the court considered that the government had no right to bring a suit to set aside a patent upon any ground which could be raised by a private individual in defense of a suit for infringement. This is a slight modification of what was apparently decided by the government in one or two former cases. But it is a legitimate doctrine and one which has something to commend itself to one's sense of propriety. Of course the government cannot afford to meddle in a patent case unless the situation is very extraordinary; and the suit which was decided would not have been brought if the extraordinary delay in the issue of the patent and the extraordinary injury thereby inflicted on the public had not been an element of the case. The suit has been productive of good results amply sufficient to justify its institution and trial. It has aroused public sentiment to the wrongs done by loose practice in the Patent Office, and contributed greatly to reform in the patent law by legislation during the last Congress. And it will undoubtedly bring about still further changes in the same direction. The decision of the court that there is no limitation to the time during which an applicant may keep his application pending in the office, provided he cannot be convicted of bribery or corruption of the officials, or the doing of any act tending to directly delay his application, calls for the enactment of some law which will put a limitation upon the time during which the proceedings may run. An excellent suggestion has been made that Congress shall enact that no patent shall run for more than 20 years after the application has been filed. That gives the applicant three years' time within which to get his patent. If he delays longer than that the life of his patent is shortened accordingly.

The Sturgis, S. D., electric light plant will furnish electric light for Fort Meade, which will save over $300 per year on the prices which have been in effect on kerosene.

COMMUNICATIONS.

Berliner and Bell Patents.

To the Editor of the WESTERN ELECTRICIAN:

I see in the *Buffalo Enquirer* of May 19th, under article entitled "Telephone Patents," the following:

"If it should be decided that Emile Berliner's patent for a transmitter is inseparable from the patent for a receiver, then they are both covered by one patent, the patent of 1891 must fail, and the 1880 patent expiring this year, the field will soon be open. But if it be decided that the transmitter and receiver patents are distinct and separate, then the patent of 1891 will continue to protect the Bell company in its cinch upon the telephone business of this country, probably until 1898."

Passing comment upon this, in the judgment of the writer there is but one electrical law in the transmission of speech. If the Bell receiver, patent of March 7, 1876, when connected to a circuit transmits speech, the transmitter of Berliner, patent of November, 1891, when connected to a circuit and transmitting speech follows the same law, as do all other kinds of apparatus.

An apple falling from a tree obeys the law of gravity, so does a church steeple when coming to earth. The receiver of Bell and the transmitter of Berliner are identical and inseparable when transmitting speech.

The Bell company during the life of the Bell receiver enlarged upon the covering capacity of its claims. The Supreme Court supported it so that there was no show for any other kind of an instrument. What was sauce for the goose in those days should be sauce for the gander at the present time.

A. S. KEATING,
Manager Corry Telephone Exchange.

Corry, Pa., May 20, 1897.

Warning to Independent Companies.

To the Editor of the WESTERN ELECTRICIAN:

I wish to sound a warning note to the opposition telephone companies. The Central Union Telephone company is making overtures to towns and cities having exchanges but where it (Central Union Telephone company) has not, to give these cities connection with long-distance lines, even going so far as to rent instruments to opposition companies. It wants to head off all toll-line construction possible. This is the only hope now, and such propositions should not be entertained, as it is only working for the downfall of all opposition. This Judas like scheme is in keeping with its methods of doing business. Anyone wishing proof of these assertions, names of companies and persons having had propositions made them, also names of companies accepting the same, may write me and I will furnish them. Companies accepting any such terms from the Central Union Telephone company or any licensee of the American Bell Telephone company, should be regarded as beneath the notice even of the Bell company.

E. B. OVERSHINER.

Logansport, Ind., May 27, 1897.

Ward Leonard Electric Company's Old and New Quarters.

The factory of the Ward Leonard Electric company of Hoboken, N. J., was entirely destroyed by fire on May 20th. The fire began in adjacent buildings and resulted in great damage in the neighborhood. Fortunatly the company was well protected by insurance, and, as usual, showed great business push by securing within 48 hours a new factory building, which is located at the corner of Seventh and Clinton streets, Hoboken, thoroughly equipped with power. The plant includes a 60 horse power Ideal engine belted to a 30 kilowatt C & C generator which distributes power through small motors over the entire building. Orders were placed for a new supply of machine tools for beginning business the next morning after the fire, and the work of equipment began at once, so that in seven days after this accident occurred the company was at work filling orders. Large fusing furnaces have been erected in the basement of the new quarters. There is a pleasant location for the executive officers. Fortunately the entire business data books, records, etc., were saved, owing to the fact that there was a large force at work over time on the evening of the fire; consequently no delay in the routine of the business will occur. In Fig. 1 will be seen the ruins of the company's old building, and in Fig. 2 there is a picture of the new quarters, where preparations are being made, on account of the additional room at hand, to increase the output of the business to a large extent.

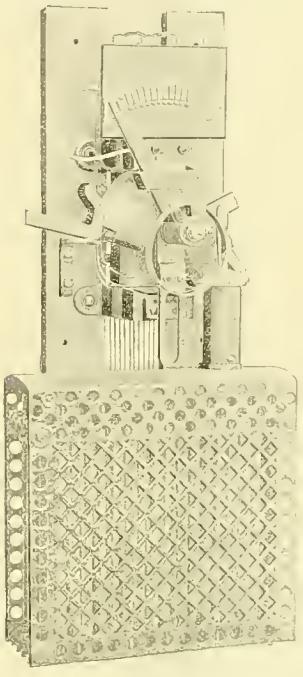
FIGS. 1 AND 2. WARD LEONARD ELECTRIC COMPANY'S OLD AND NEW QUARTERS.

Starter for Elevator Motors.

For some months past the Card Electric company of Mansfield, Ohio, has been experimenting and making careful tests with various forms of automatic starters or controllers for elevator motors, with the result illustrated in the accompanying cut—a motor starter containing features of construction that would seem to make it a very effective and durable apparatus for the hard duty of operating the common every-day kind of freight or passenger elevator.

The rheostat and operating parts of the starter are mounted on a neatly finished wood frame, and all the connections between the rheostat and cut-out are made before leaving the factory. The construction of the automatic rheostat cut-out is simple, and the magnetic force to operate it is very strong, far in excess of any possible requirements. This part of the apparatus has received careful attention, since the practical success of the starter depends almost entirely on the reliability of the swinging arm to properly divert current from the rheostat when the circuit is closed. The electro-magnet used for this purpose is a powerful one, and has a swinging armature wound and energized by the same current which creates a powerful torque, and this torque is so controlled by the connecting mechanism that a constant steady pull is maintained throughout the full movement of the arm. The speed of the cut-out can be made anything desired. All the bearings and moving parts are mounted on rollers or balls, dispensing entirely with the necessity of ever oiling them, and eliminating any possible danger of sticking because of accumulated dirt or friction.

The dash-pot for controlling the "on" movement of the swinging arm has some novel features to insure regularity and constant speed, and the release value in it is so proportioned and constructed that an almost instaneous throw of the swinging arm to the "off" position is effected whenever the current is interrupted.



STARTER FOR ELEVATOR MOTORS.

The rheostat used with this starter is of the well-known Card type, made up of iron wire coils, mounted on iron frames, put together in a substantial manner with free ventilation on all sides. Perforated iron plates protect the front and back. The reversing switch, which is a part of the Card company's elevator equipment, is of the quick-throw type, and has carbon break tips on all the contact blades. A combination of this starter and switch with any one of the several types of motors built by the Card company makes a very substantial equipment for either freight or passenger elevators.

NEW ELECTRIC CIGAR LIGHTER.

New Electric Cigar Lighter.

The accompanying cut illustrates a new electric cigar lighter now being exploited by the International Electric company of 1506 Chemical building, St. Louis. This device is useful as well as ornamental, and it may be adapted for advertising as well as for lighting cigars.

As a cigar lighter the apparatus is always ready and cannot get out of repair. It is claimed that as the current is on only when in actual use it is cheaper than any other means of lighting cigars. It saves the litter and danger from fire usual from burned matches, etc., as well as saving the matches often carried off. It avoids injury to handsome furniture and fittings, due to careless scratching of matches, and as an attractive novelty it helps trade. As a means of advertising, its advantages are obvious. The advertisement being suddenly, unexpectedly and brilliantly flashed before the eyes, commands and holds attention to a degree impossible in a mere sign, and lastingly impresses itself on the mind.

The lighter cannot of course be blown out by the wind; no alcohol is used, and there is no dry or wet battery. As soon as the handle is lifted the platinum wires in the end of handle are made red hot and the sign in the drum immediately illuminated, and when the handle is dropped the current is cut off. The stand is nickel-plated and mounted on a circular marble base.

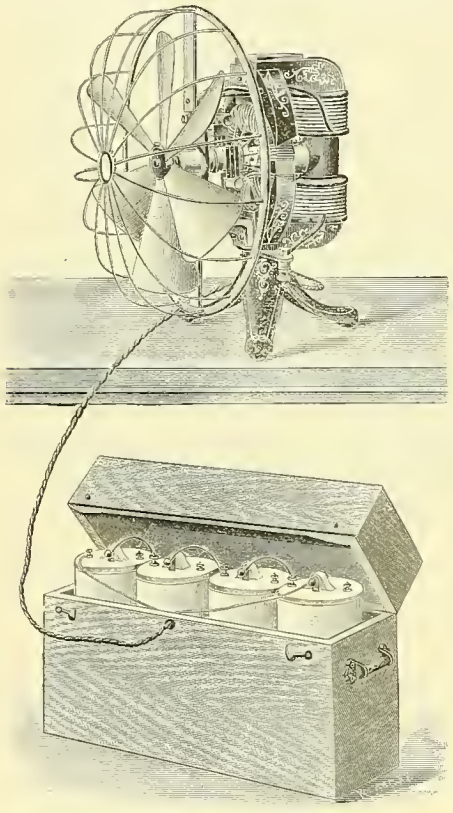
A scheme is on foot to run Kansas City power plants, manufactories, street railways, etc., by electricity, to be generated at Leavenworth, Kan., where fuel can be obtained cheaply. In addition it is proposed ultimately to construct an electric railroad between the two cities. Already arrangements to construct a $1,500,000 power plant at Leavenworth are said to have been made. The scheme is headed by Col. D. A. McKibbon, Maj. John M. Long, Harvey M. Rush, George W. Kirkstead and ex-Senator Caldwell of Leavenworth, all wealthy men; and, it is said, that other capitalists are also interested.

Fan Motors for Battery or Incandescent Circuits.

The Edison Manufacturing company of New York is again calling attention to its fan motor outfits. The iron-clad outfit carries a seven-inch fan and is now provided with a guard. The batteries operating this motor consist of three Edison-Lalande cells and the motor runs at about 1,200 revolutions per minute on this battery. The motor is said to be a very efficient one and the battery will run the fan for 150 hours before needing to be recharged.

The nine-inch Edison fan motor outfit shown in the cut has been greatly improved this season. The motor is much more efficient and now runs the fan at about 900 revolutions per minute on a little more than two amperes of current, when using the battery supplied with this outfit, which consists of four Edison-Lalande cells in polished oak case. The greatest attention has been paid to the elimination of all unnecessary friction in the moving parts, and the motor is now placed on the market as the most efficient battery motor that has yet been constructed. It is provided with self-oiling bearings and the workmanship is of the highest grade.

This company has made a new departure this year in bringing out a nine-inch fan motor to run on 110 to 120 volt direct current circuits. This motor is similar in



FAN MOTORS FOR BATTERY OR INCANDESCENT CIRCUITS.

construction to the nine-inch Edison battery fan motor, but is wound for the electric light circuit and will run right across the line. It is provided with three speeds and will run 1,400, 1,700 and 2,100 revolutions per minute respectively. It is of high efficiency, the watts used at these three speeds being only 36, 48 and 60 respectively.

Improved Samson Battery Cells.

The Samson battery, one of the oldest and most prominent open-circuit cells, has recently been changed, as shown by the illustrations. These changes, which have made a great improvement in the battery, have been mainly mechanical. The carbon connection, which, should occasion require, could not be renewed in the old style, is now made removable, and is larger and stronger and tinned to prevent corrosion. The carbon of French production is hollow and filled with a depolarizing compound, as shown in Fig. 1. It is made with a screw-top, which fastens securely into a threaded cover.

The zinc has also been changed, and now has three projections at the top, which fit into a groove in the cover, and is held firmly in place against it by a large knurled nut placed on the zinc stem. This arrangement admits of placing the elements in position before shipping, and the only necessary handling after taking the cell from the packing case is to remove the excelsior from around the elements and replace them in the jar, after having first added the sal-ammoniac solution. The rubber plugs and bands used in the old style, which collected the salts formed during action and were liable to allow a short-circuit to be made between the elements if care was not used, are thus dispensed with. The manufacturers of the Samson claim that it is the only open-circuit battery "shipped set up."

Fig. 2 shows the "special" form of the Samson. This style is especially adapted for use where a large current is not required but long and continued service is a necessity. It has been used extensively for operating railroad crossing gongs, and a number of telephone manufacturers are using it for telephone work, for which it seems particularly adapted. The regular style (Fig. 3) fitted with a circular zinc, is used for electric gas lighting, gas engines, and all places where a strong battery with a large output, combined with quick recovery, is required.

This battery has had a large and increasing sale ever since its first introduction by the Electric Gas Lighting company of Boston, Mass., and is now handled, it is said, by all the supply houses in the country.

Electrical Railway Signaling.

At a meeting of the Institution of Junior Engineers held at the Westminster Palace hotel on May 7th, a paper on "Electrical Railway Signaling" was read by L. G. Ferreira, electrical engineer of the North London railway. The following is a brief resume of the paper from the London *Electrical Engineer:*

After summarizing the history of the development of the single needle by Varley and Spagnoletti (which system formed the basis of nearly all visual signaling apparatus), and briefly describing the various instruments for transmitting messages, the author proceeded to consider the working of the "absolute block system," mentioning the various block instruments in use. As instancing the great amount of work required to be done by the instruments on an urban railway, it was stated that on some lines 16 beats were given and received on the bells and three movements of the needle made to signal the passage of each train, and where there were four sets of rails the number of trains per 24 hours might run into four figures. It was of the highest importance, therefore, that the instruments should be of sound mechanical as well as electrical design to stand wear and tear, and for the parts to be interchangeable, so that in case of failure they could be easily and quickly replaced.

A detailed description was then given of the block instrument designed by the author in conjunction with H. J. Pryce, the locomotive superintendent of the North London railway, which line is now worked throughout by it. A pair of instruments was shown in actual operation at the meeting, and the various parts open to examination. In this instrument the needles had an angular movement of nearly 90 degrees instead of the usual 30 degrees, and when the circuit was opened they resumed the normal position, not only by gravity, but by magnetic attraction. The needle arbor carried a cylinder of soft iron slotted at diametrically opposite points. A permanent magnet had its poles brought close to the cylinder at the extremities of the vertical diameter, and an electro-magnet had its poles similarly arranged horizontally. When there was no current flowing through the electro-magnet the cylinder took up a position with the slots, central to the permanent magnet poles, owing to the two halves tending to arrange themselves in the direction of the lines of force, and the needle was thus held in a vertical position, but when a current was passing through the electro-magnet the direction of the lines of force was altered, and the cylinder turned through an angle of 45 degrees. In order to minimize the effect of any residual magnetism in the electro-magnet the cylinder was reduced in width for some distance midway by the half circumference between the slots. By so doing less of its area was exposed to the action of the electro-magnet when the needle was in a vertical position, and a differential effect was produced, the permanent magnet having a greater effect on the cylinder when within a few degrees of its normal position, and the electro-magnet the greater effect when the cylinder had revolved sufficiently to bring the full width near its poles. To prevent the needles being moved without giving an audible signal the ringing key was arranged to lock the commutator, so that at least one ring must be given on the bell before the needles could be moved. The ringing key was so arranged that all the contacts were made by rounded pins rubbing on springs with cylindrical tops, which insured a perfectly clean surface for the actual contact, as any sparking or oxidation occurred on one part of the same, and the point of contact traveled round as the key moved and finally rested at another place on the surface of both pin and spring. The actual duration of the contact was also much longer than with a butting contact, and thus allowed the instrument to be worked much quicker. There was a special arrangement for junctions so as to lock one instrument with another, that trains could not be accepted from two cabins on converging lines at the same time.

The paper then dealt with repeaters and light indicators, and described the form and arrangement of circuit mostly in use, after which the step-by-step train describer was briefly referred to. Telephones, and methods of grouping them so as to obtain intercommunication between each and all the cabins on a railway or section of a railway, were then considered, special mention being made of the conditions necessary to arrive at the best acoustic results. The method recommended was an arrangement by which the telephones were grouped between two wires in "multiple" in sections of six or eight, with special switches to join up one section to the next, the relays being wound to a high resistance (varying in proportion to that of the line wire and their relative distances apart) also in "multiple."

Fig. 2.

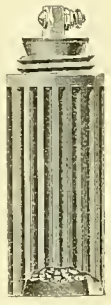


Fig. 1.

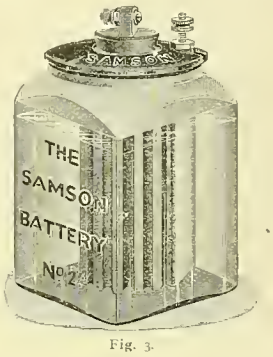


Fig. 3.

IMPROVED SAMSON BATTERY CELLS.

Limitations of Government in Water Power Plants.

By Mark A. Replogle.

Part II.

"Capacity of plant for stored energy," the third element to be considered in the government of water power, is perhaps the most important factor, and often receives the least consideration. It is too often a chance factor. The capacity of the plant for stored energy may be easily understood. The following comparison partially illustrates this idea: To reduce the walls of a fortress may require a gang of laborers to use their united energy for several months of time, yet a few hundred pounds of steel in the form of a projectile fired from a cannon can in an instant be charged with energy enough to carry it a number of miles, and at the end of its flight it yet may retain power enough to reduce the fortress in a moment of time. This principle of storing energy in material in motion is the fundamental principle of all speed government.

If the above cannon ball were forged into a fly-wheel and could be revolved on its axle with such rapidity that its average speed equaled the velocity that it had when fired from the cannon, it would contain the same quantity of energy, and this quantity might amount to many thousands of foot-pounds per second. In speed regulation this stored energy can be used to supply the demands for power until gravity can generate it; in like manner this capacity for energy storage can absorb power when the load has decreased until the power supply can be cut off. It can readily be seen that any and all of the moving or revolving parts of a power plant are storehouses for energy, and their capacity depends upon their weights and velocities. The physical laws governing the quantities of energy under the various conditions are well understood by our scientists and engineers; hence, advantage can be taken of them in the construction of our modern water power plants.

The careful steam engine builder has learned by experience that he must provide this power storage capacity in his engine, and he varies it according to what is required of it in government. There is no doubt that the use of fly-wheels on engines is a result of experience in trying to maintain even speed, and that their prime purpose is to carry any change in load until the power supply from the boiler can be brought into play to carry the new load and to supply the power that the fly-wheel gave out in advance of it. The time required to get gravity effects is always greater than the time required to get the expansive effects of steam; therefore, the capacity for power storage should be correspondingly greater in water powers if the same efficiency of regulation is required.

The momentum of water power plants is often very much less than that of steam-power plants, and this lessens the possibilities of government to an extent deter-

mined by the changes in load, the time required for gravity to act, and the quantity of power stored in the moving parts of the plant. This factor, power storage, cannot be too carefully considered. It is the factor above all others that the designer of a water power plant can most easily control. It is the one factor that can be varied to counteract all the bad effects of all the others; therefore, an intelligent application of it should be made in all water power plants where good government is important.

The last factor to be considered is the "governor." The governor is often considered to be the most important factor in the government of a water power; but it is only one of the important factors, and if it is a perfect machine it may still be limited in its efficiency by the three above discussed factors. A good governor can only play the part of an honest judge. Evidences of strife in the form of changes in load are placed before it; facts of design and construction are placed at its disposal; the unerring laws of physics are brought to bear upon each new case, and honest judgment is meted out in the form of speed or government of the plant, and no jury or supreme court can set aside the verdict.

A good governor must move the wheel gates as fast as gravity will respond in giving the proper velocity to the increased quantity of water required to supply the demand made for power. If it operates too fast, the results are detrimental to good government. The governor must have wrought into it the principles that co-operate with the power storage of the plant. It must be so designed and constructed that it will stop moving the gates when they have reached the proper position to supply power for the new condition of load. A good governor must make its judgments quickly and accurately, always returning the speed to normal after correcting the inertia and momentum effects of the change in load. A good governor should also be simple in design and mechanism; otherwise, it will be an expensive and unsatisfactory part of the plant. The constant and reliable duty expected of a governor requires it to be a powerful machine; the positive and quick judgments it must make require it to be sensitive and delicate in some of its parts, and the importance of its position in a plant requires it to be symmetrical in appearance and mechanically perfect in its construction.

The possible regulation in a water power plant need no longer be a matter of experiment and doubt. The designer of such a plant need no longer be in darkness as to the government of his plant until he has experimented with several governors. He can design his plant for any desired efficiency of regulation, and a properly designed governor can govern it.

All plants already built are capable of a certain degree of regulation. If this degree is not satisfactory, and figures show that it cannot be improved, then further calculations will show positively what changes must be made in order to obtain the desired results.

In conclusion, it should be said that if the limitations of water power government were investigated more carefully, there would be less doubt concerning the possibilities of government, and no doubt concerning the results in any particular case. Many of our conservative engineers, who have not taken time to make these investigations, have still some doubts regarding reliable and automatic government of water powers; but the results, where these limitations have been intelligently calculated and the proper remedies applied, prove beyond all doubt that any desired efficiency of government can be provided for, even to the finest steam-engine practice.

Lake Shore Convention Train.

Delegates to the convention of the National Electric Light association may leave Chicago via the Lake Shore & Michigan Southern railway at 5:30 P. M. (New York limited) and arrive at Niagara Falls, via Buffalo, the next morning. No extra fare will be charged on this train, as has been customary, and this, together with the fast time, superb accommodations, etc., makes it an extremely desirable train to take. The capacity is limited and those desiring accommodations should make early application. Address office of the WESTERN ELECTRICIAN or city office of the Lake Shore & Michigan Southern railway, 180 Clark street. Unlimited tickets to Niagara Falls, allowing stop-over at any point between Chicago and Buffalo, inclusive, are only 50 cents higher, and if procured within the conditions of the certificate in no wise affect the one-third limited fare returning.

Actual Improvement in Trade.

Dun's last review of the commercial world contains the statement that people are actually doing more business than they realize. This is explained by the fact that they reckon by values, but these are much lower than in any previous year of prosperity and leave little margin for profits. In quantity there is almost as much business being done as the years of the greatest prosperity, and, though the increase in population would call for a material expansion, the comparison is not discouraging. The recovery is slow, hesitating and gradual, but more has been done on the whole in May than in April, while returns of April showed the volume of business only 10 per cent. smaller than that of the best year heretofore. Yet hesitation is doing its work every week, and multitudes are waiting, because of possibilities at Washington, who ought to be filling the demand for labor and the products of labor.

The appraisers who were to name a price for the electric light plant at Mount Pleasant, Iowa, at which the city could purchase the plant, have completed their work and the city will vote June 7th on purchasing it.

Advice to Builders of Electric Railways.

By G. WHITEFIELD CHANCE.

As president, manager or superintendent of a railway system, you are interested in motors, brakes, coal bills, salaries of employes, and most of all, earnings. You try to figure down your operating expenses, but perhaps, like the famous ghost, they will not down. You are looking for leaks. Can you see prospective dividends vanishing before inevitable repairs and renewals?

What do you think of a large city system of electric roads with a nine inch girder rail, under a traffic of 450 car trips per day, after three years' service, crying through motors, cars and riders, for reconstruction. And yet this is only one case out of scores where material was all right but handling all wrong. You are an able financier and manager, but perhaps are handicapped by the lack of foresight of someone.

Roadbed.—In interurban railroad building along country roads, the question of drainage is most important; so also in cities this is an important question, except with good foundation and practically watertight pavement, or where the track is laid on concrete. Often a cheap line of drain tile is as effective as a foot of stone ballast. Especially on comparatively light traffic roads designed to be built cheaply will correct drainage treatment show marked saving. Experience on steam roads has taught us that we dare not obstruct nature, and yet how often is precedent thrown aside? To fully appreciate the value of drain tile one must have lived in or visited "the drain tile states."

Concreting.—There is more money thrown away in bad foundation work than is generally realized. But this special part of your track work is frequently a case of "the devil take the hindermost." If you are laying rails in cities, where excavation is required, no more material should be taken out than is absolutely necessary to get in the foundations. Some work is very loosely done in this respect; a solid bottom should be insisted on in any case. If you are laying where the roadbed can be rolled, it should be done by all means. If heavy traffic is the word, concrete first, last and all the time, and perhaps you may do away with ties entirely, if the conditions are favorable.

Ties.—There are two standard ties in this country, white oak and yellow pine. I have learned, as we all have who have had much to do with the question, that there are ties and ties, and that a competent inspector will save a small fortune to a large company. How many roads in building or even in renewals get what their specifications call for? While there are two standard woods, others may be used in certain localities by using good judgment as to traffic and local conditions, and then comes in the question of the tie plate, its advisability and form, questions again of suiting your appliances to your conditions. A cypress or cedar tie with a tie plate, in certain localities, may be much better and more expedient than a harder wood. A tie plate, even with hardwood ties, is a great saver with heavy traffic or tortuous alignment. Yet again, it may be unnecessary with easy alignment and light traffic. Timber treatment, creosoting and and kyanizing are well known methods of increasing the life of the tie and may be used with judgment in certain cases.

Rails.—There has been much written about rails, chemical composition, length, form, etc. For nearly all purposes of track construction, the long rail, preferably the 60 foot rail, has come to stay. The broad, shallow head, high web and moderately wide base give the best results. Where tie plates are to be used, we would naturally use a moderately wide base, but the market forms will have to govern the selection in most cases. The American society rail or T rail work is good and practical. All the high girders by the principal American mills are good in practice, but the foreign girders are generally of bad head design. Perhaps a rail with greater base width than common would give better results when laid directly on concrete. The chemical composition, heat treatment, and mill inspection are points too little looked after in giving rail contracts. High carbon, low phosphorous and sulphur with a proper heat treatment, is the "battle cry" for good rails. It is entirely reasonable to allow a harder, even if more brittle, rail in sheet girder work than in steam work, where a broken rail may mean loss of life and property.

Joints.—These should be good, or none at all; that is, your rail can be practically continuous if you bury it in rigid paving. We are not yet to the point of laying continuous rail in open track, although recent experiments with cast joint continuous rail seem to point that way. By laying so as to make the stress generally one of tension with perhaps a slight compressive one at times, and using proper anchorages at curves, we may attain to a continuous rail in open track. But when you must have a joint let it be the best. If you are using a low rail, use a heavier joint plate in proportion than with a high rail. I would much prefer a joint plate of the type that drops below the base for a T rail, or a combined tie and joint plate. The mistake is nearly general in using a small joint plate with a small rail, with the consequence of a bad track, surface bent rails and general inefficiency. The poor fish-splice used with light rails has done more to condemn the rail than the rail itself. My own experience and that of many experts has demonstrated the fact that light rails wear proportionally better than those of heavier section. This is explained by the fact that the head of a light rail gets more work done on it by the rolls and is of a denser construction. In the matter of continuous rails the cast joint is cheaper than the electric weld, by something less than half, a nine inch cast weld joint costing about $3.50, while an electric weld of the same rail costs about $5 per joint.

Bonding.—Whatever style it be, copper, plastic alloy electric or brazing weld, let it be well done, to which end thorough inspection is necessary, for as with all track work, we usually say good-bye to this part of the system when the "fillers-in" come along. With the cast joint there is a difference of opinion as to the necessity for bonding, some bonding their joints and others maintaining this unnecessary. However, if the right means are at hand, the cast joint can probably be made electrically sound.

Special Work.—Having been engaged in the manufacture of special work for some time, I may here add a word or two of interest and value. We have frogs and crossings now with hard centers—manganese, Harveyized and case hardened. They are all good and fastened about the same in the first two cases. We have also solid cast steel pieces which are well made. While certain pieces of one manufacture will outwear those of another manufacture in a certain locality, the difference on the average is slight and great difference of wear can generally be traced to non-uniformity of product. On this account, a guarantee from the maker is in order. The trouble with this class of work is that it is more or less going through the experimental stage. Where you have curves of very sharp radius with heavy traffic, a special steel should be considered. Manganese is the best yet found. Your curves should of course have easements and the outer rail should be elevated if possible. All curve rails, whether T or girder, of less than 500 feet radius, should be bent at the mill, and if of heavy section, up to 750 feet radius. Switches and mates are also made with special steels in tongues and central wearing parts. These are the best, but for light traffic the less expensive styles will do; however, all depends on how light the traffic is.

Bridges and Culverts.—The number of bridge accidents on suburban trolley lines has been too great. Don't take any risk; you cannot afford to, even if you are operating a cheap line, for if you lose a bridge and a few lives culpably, where will dividends for years go to? Better err on the side of safety, if you must err, but with competent supervision and careful inspection there should be no error and indeed no unreasonable expense. A guarantee or insurance may relieve you of pecuniary responsibility, but for the good name of your road you cannot afford to have accidents. "Sufficiency" is the word. Don't try to make water run up hill. Give it room.

Overhead Line Work and Conduits.—Your pole line, frogs, conduits, etc., should be good construction and standard practice. There are so many electrical nostrums in the way of overhead fixtures that it takes some care to select the best for the money expended. Poles should be set in concrete. Compressed mica insulators are the best. Creosoted wooden ducts for cables are standard. When the third-rail system can be used, it is best and cheapest.

Motive Power.—You may be pleased and edified to note the progress made in compressed air, gas, steam and other motors, but experience teaches and it has not yet demonstrated these motors to be superior for urban and ordinary suburban service. The accumulator car, and compressed air motors, are worthy of study, and in certain situations these motive powers may yet find a field.

Power Stations.—The subject of location is both a mathematical and ordinary financial one, and should be

left largely to the engineer. For a first-class plant of large units compound condensing engines, water-tube boilers, automatic stokers, economizers and direct-connected generators are the essentials of economical operation. For a small plant, high speed automatic engines, with belted generators, give good results, while the automatic stoker and economizer may be dispensed with. The subject of pure water supply, purifiers, heaters, pumps, separators and condensers are details that must be worked out in each case.

Cars.—For urban service the single truck car is best, for fast interurban service the double truck car has many advantages. The simpler the truck the better, providing the principle is all right. For fast service something more than the hand brake should be used. The air brake and electric disk brake are both available. The latter has been brought to a state of perfection that will probably meet all requirements, and it possesses the advantage of a direct method of application of power.

Operation.—There is entirely too much looseness in methods of operation of electric interurban roads. For single track lines, either a dispatcher system with orders should be used or an electric train staff system or automatic block. With double track lines an automatic electric block system will meet all requirements.

Canadian Power Privileges at Niagara Falls.

The question that is uppermost in the minds of those interested in the development of the electrical resources of the Dominion is the utilization of the Canadian power privileges of Niagara. The Victoria park commissioners have made an elaborate study of the questions involved and they have urged the granting of additional time to the company holding the franchise, but up to the present without success. In the early part of the year, the commissioners say, application was made by the company having the privilege of developing electrical power for commercial purposes from the waters of Niagara river within the park for an 18 months' extension of the time within which, under their agreement with the commissioners, dated April 7, 1892, the initial works were to be constructed. Many meetings were held with the representatives of the company, and a large volume of correspondence was carried on during the year, in order that the commissioners might become fully informed of the reasons that called for the extension of the time limit on the part of the company. The commissioners also desired to consider all the circumstances and conditions involved in the application, and their bearing upon the future interests of the park.

As the subject is not only of great public importance but vitally affects the future interests of the park, and as considerable opposition was manifested to an extension of the time limit or to any variation of the agreement with the company by residents of the Niagara district, the commissioners felt that a historic resume of all the facts connected with the utilization of the water power of the falls should be made public, so that an intelligent opinion might be formed in reference to the subject. The report says:

At the outset the fact must again be emphasized that in founding the park the government of Ontario made it a *sine qua non* that its establishment should not entail any financial burden on the Province, but that the property should be made to yield a revenue sufficient for its yearly maintenance and improvement, and in addition pay interest on the whole outlay necessary for the purchase of the lands and for the extension work of reclamation and reconstruction. The necessity of providing annually a sum of not less than $40,000 for this purpose had from the beginning a most important bearing upon the policy of the commissioners. Having made efforts for some years to secure this very large revenue, without success, the commissioners were compelled to look for new sources of income, and among these their attention was naturally drawn to the immense water power of the falls as one of the most promising means at command for raising revenue, more especially as a great enterprise had been organized on the American side, having in view the utilizing of the water power of the falls for commercial purposes. In the early part of the year 1889 a proposal was received by the commissioners on behalf of a number of American gentlemen, among whom was ex-Governor Cornell and other well-known capitalists, for a grant under which some of the water power of the horseshoe falls could be used for the purpose of generating electricity as a motive power and for lighting purposes, not only for local requirements, but for transmission to cities and towns in Canada and the United States.

The commissioners carefully considered the subject in all its bearings, and decided that certain conditions should govern any agreement which might be arrived at, viz.: that all the constructions required for electrical works should be placed as far as possible from the bank of the river, and in a manner which would not detract from the park design, and that all such works should be subject to the approval of the park commissioners, both as to position and character; and further, that the conduct of operations within the park should be subject to the rules and regulations framed by the commissioners.

After protracted negotiations with the American applicants for the granting of a franchise on these conditions, an agreement was finally entered into, under which the lessees were to pay $25,000 per annum, of which two years' rent was to be paid in advance, and at the expiration of 10 years the rental was to be increased at the rate of $1,000 per annum, until it reached $35,000 per annum in the 20th year. It was further agreed that the lease should be extended for four further terms of 20 years, at the maximum rental of $35,000 per year.

Time was given to the promoters to enable them to organize as an incorporated company, and to obtain the requisite capital to successfully carry on the operations. Having failed to accomplish this, however, the park commissioners were finally compelled to terminate the negotiations.

Some time after proposals for privileges similar to those arranged for with the American capitalists were received on behalf of Mr. Ferranti, an eminent English electrician, who, in association with well-known London capitalists, was then engaged in constructing an extensive electrical plant in London. As an evidence of good faith $10,000 was required as a forfeitable payment, and one year was granted in which to organize and conclude a definite contract. Owing to unforeseen delays and to the seemingly interminable difficulties in connection with the problem of transmission from their power station at Deptford to their London station, a distance of over nine miles, the time for the closing of the contract passed and the deposit was forfeited. Several offers were then made on behalf of other United States capitalists who were desirous of securing the franchise, but as they all asked for a considerable reduction in the annual rental that had been previously decided upon, and proposed the payment of royalties and other considerations in lieu of such rental, the negotiations were necessarily abortive.

After some time had elapsed the English capitalists renewed their application for the franchise, and having paid a second sum of $10,000 as a forfeitable deposit, the option was renewed. Efforts, however, to finance the scheme in England again failed, but the representative of the English capitalists at last succeeded in inducing the present holders of the franchise, who are men in command of unlimited capital, to join the English capital, to take up the options and pay in the large sum necessary to make up the two years' rental, whereupon an agreement was executed in April, 1892, and ratified by the Legislature of Ontario at the spring session in that year. Under the terms of this agreement the company was granted until May, 1897, to prepare plans, arrange finances, and begin work, which was to be sufficiently advanced on the 1st of November, 1898, to have water connections made for 25,000 horse power, and to have actually ready for use, supply and transmission 10,000 electrical horse power.

Since the execution of the agreement the holders of the franchise complied with the financial obligations imposed, and paid in the sum of $100,000 as rental up to November 1, 1896, without receiving any material benefit therefrom. They then represented that as the transmission of electricity for considerable distances was still in the experimental stage, and that before beginning work it was desirable, if not necessary, that this problem should be successfully solved, additional time should be given for the completion of the work stipulated in the agreement to be ready by November 1, 1898.

It may be pointed out that the works of the Niagara Falls Power company, which are situated on the American side, and which are based on precisely the same principle of development of the water power, and for which no rental is paid the state, have been up to the present time wholly unremunerative, although the expenditure on the works and plant to date is stated to have been over $5,000,000.

The commissioners therefore approved the extension. "In view of the magnitude of the operations required for the carrying out of this gigantic undertaking, and the exceptional character of the machinery employed," the commissioners recommended that sufficient time be given the Canadian company in which to thoroughly test and perfect all the appliances necessary to secure the success of the enterprise before operations began; and although it would appear that a somewhat smaller expenditure of capital would be called for in the execution of the works on the Canadian side, it will undoubtedly require an outlay of millions of dollars to complete the works which have already been submitted for the approval of the commissioners. The report adds:

When the great financial responsibility and keen business experience of the group of English and American capitalists forming the Canadian Niagara Power company is taken into account, it must be admitted that it would be difficult to obtain a company more capable of developing the work in a broad and comprehensive scale, and that their application for an additional period of 18 months (during which rental is to be personally guaranteed) is at least well worthy of consideration.

It has always appeared to the commissioners improbable that a market could be found in the vicinity of the Falls on the Canadian side for large units of electrical power, at least for years to come, but that the success of the enterprise must depend chiefly on the possibility of transmitting the energy over a wide area and distributing it to large and small consumers in cities and towns more or less remote from the Falls. The difficulties attending the economic transmission of electric power even to places as near to the Falls as Hamilton or Toronto, do not appear to be as yet fully overcome, while the machinery and appliances required to convey and deliver the energy to consumers will under any circumstances require the expenditure of vast sums of money. It will thus be quite apparent that only an organization having the command of unlimited capital and the knowledge which alone comes from experience could reasonably hope to obtain a successful future.

Attention is called to a temporary power arrangement proposed. In order to provide ample facilities for meeting any demand for electrical power which may arise prior to the carrying out of the works, the company offered to arrange with the Niagara Falls Park & River Railway company, subject to the approval of the government, for the temporary use of the surplus power which can be made available at short notice in the power house of that company, and it was also intimated that the main works would be gone on with immediately it is found possible to secure responsible customers in the vicinity of the falls on the Canadian side to assure a market for the use of even 5,000 electrical horse power. Having in mind the foregoing considerations, and the difficulties and delays which attended the securing of reliable parties to take up the franchise in the first instance, and, above all, the responsibility resting upon them to secure the large revenue needed to maintain the park and its extensive outlaying territories, the commissioners, after careful consideration of the whole subject, decided to recommend the government to grant the extension of 18 months asked for, on condition that the company should not exercise the option in the agreement to terminate the same during the period covered by the extension, but that the payment of the stipulated rental should be guaranteed for that time, and that in the event of a local demand for electric power arising in the interval, the company should be authorized to arrange for the temporary use of the Niagara Falls Park & River railway surplus power, but that the use of such power should not be sanctioned beyond the date of the extension asked for, nor to an extent beyond the present capacity of the railway wheelpits and buildings. It is believed that a reconsideration of the report will be obtained and the desired extension granted at an early day.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 29.—Justice Beach's decision that the city's right to purchase the Eighth Avenue railroad, under the resolution of 1851, by which the franchise was granted, no longer exists, and that the Metropolitan Street Railway company may change the motive power on the road from horse power to electricity, has caused a great commotion. The city's right to purchase the road, Justice Beach says, "is dead beyond hope of recovery." The motion for injunctions to restrain the owners of the road from changing the motive power on it he denied with costs, and he also declared that the city's Board of Electrical Control had no jurisdiction in the case. The Eighth Avenue railroad alone is mentioned in the decision, which, however, practically affects the questions of the purchase of and change of motive power on the Sixth avenue line also. At the meeting of the railroad committee of the aldermen on Monday in the council chamber there was great disorder, expressive of the dissatisfaction felt by labor orators and others with the course of the city officials. Finally the committee agreed to consider an agreement to the effect that the mayor and Board of Aldermen shall begin at once in the Supreme Court action to determine the city's rights, and that, pending the determination of the action, the company go ahead with its plans to change the motive power, the permit not to be considered a waiver of the city's rights or prejudicial to the city's interests; that, in the event of the city's winning, the franchise be then sold at auction, the purchaser to pay the present owners the original cost of construction, with 10 per cent. additional, and to reimburse the company for its outlay with six per cent. interest.

According to the *Sun*, the conductors on some of the Long Island trolley lines carry "side lines," as it were, and solicit business of passengers. This story is related in instance: "A trolley car that left Astoria for

Flushing had three passengers and just such a conductor. As sooo as he had collected the fares he stopped beside one of the passengers and said. 'Live in Flushing? No? Well, here is my name (handing out a card advertising certain wares, and bearing the conductor's name written in pencil). That's a bang-up firm that I represent. If you want anything in my line let me know, and I will call around at your house with my samples. We guarantee all our goods as the very best, and if you buy anything we will emboss your initial on it. You see I do this in connection with my railroad business. I can't carry samples, but I distribute my cards and then call on my customers after hours. Yes; there are other conductors who do outside business. There isn't much in railroadiog, you know." S. M.

Northwestern Notations.

MINNEAPOLIS, May 29.—The Sioux City Traction company of Sioux City, Iowa, contemplates making some changes in its system, double tracking West Seventh street, using Pierce street more extensively and resumiog operations on Sixth, between Pierce and Pearl streets.

The city of Stillwater, Minn., will vote on giving a boous of $5,000 to anyone who will purchase and operate the street railway line.

The Ely, Minn., Council contemplates buying a new dynamo for the electric light plant.

John A. Bramball of Des Moines, Iowa, has made a proposition to Adel, Iowa, to put in an electric light plant if citizens will raise half the first cost of the plant.

The District Court at St. Cloud, Minn., has decided against the city of Little Falls, Minn., io the case against the electric light and water company, where the city sought to annul the contract on the ground that the Council had not the right to enter into a long-time contract. The contracts were for 30 years.

A new electric light company has been incorporated at Cedar Falls, Iowa, and purchased the old plant. Numerous improvements will be made on it.

The Albert Lea Electric company has put two electric stoves in Jorgenson's bakery in Albert Lea, Minn.

The Breckenridge, Minn., City Council will be petitioned to purchase an electric light plant.

The Fort Wayne electric corporation secured the contract to furnish an electric light plant for Winthrop, Minn.

Work will be begun shortly on the conduits for carrying electric wires for the St. Paul electric cars from the Minneapolis power dam.

Outside bondholders in the street car line of St. Cloud, Minn., want the local bondholders to give up their holdings in order that the former may have full control, in which event they would put in $10,000 in improvements to the system. There are about $85,000 worth of bonds held by outsiders and $17,000 by St. Cloud parties.

The electric light election in Hancock, Mich., resulted in a vote of 425 for and 221 against, lacking 11 votes of the necessary two-thirds. The contracts for the plant awarded a short time since are therefore annulled.

The Crookston, Minn., Water Power & Light company is now giving 24-hour service.

A local company is preparing to establish an electric light plant in Sanborn, Iowa.

R. C. Foster has sold the electric light plant at Black River Falls, Wis., to Robert Mason, who will make many improvements to the system.

The Muscatine electric railway of Muscatine, Iowa, will have its power and rolling stock considerably augmented.

The city of Manchester, Iowa, has entered into a contract with the electric light company for lighting for two years at $7 per light for service until midnight.

The Apple River Power company has been incorporated at New Richmond, Wis., to develop Apple River Falls and transmit the power over wires to New Richmond and other points. C.

PERSONAL.

C. K. King, secretary of the Ohio Brass company of Mansfield, O., was in Chicago last week.

R. E. Gannon, superintendent and manager of the Cape Girardeau Water Works and Electric Light company, Cape Girardeau, Mo., was visiting friends in St. Louis last week. Mr. Gannon came on business, but found time to enjoy some of the pleasures of that hospitable city.

The following named out-of-town visitors registered at the headquarters of the National Electric Light association during the week ended May 28th: J. W. Wilson, Sheffield, England; E. L. Babcock, Cuyahoga Falls, Ohio; E. B. Douglass, Allentown, Pa.; W. N. Stewart, London, England; W. F. Bossert, Utica, N. Y., and H. T. Edgar, Atlanta, Ga.

Cards have been issued for the wedding of E. J Nally of Chicago to Miss Lee Warren Redd, at Lexington, Kentucky, on May 10th. Mr. Nally is assistant general superintendent of the Postal Telegraph-cable company and he is undoubtedly one of the most popular officials of that corporation. He has been eminently successful in the field of telegraphy and has established an enviable reputation among electrical and commercial men. The WESTERN ELECTRICIAN extends congratulations to Mr. Nally and echoes the good wishes of his numerous friends for his happiness and prosperity.

I. R. Edmands, who has been the representative of the General Electric company at Niagara Falls, has been called to Schenectady to conduct the test of electrical apparatus which is to be installed in St. Paul, Minn., in connection with one of the Pillsbury water developments for generating 10,000 horse power to operate the street cars of Minneapolis and St. Paul. Mr. Edmands will probably be at the Falls a fortnight, when he will go to Schenectady, where he will remain two months before going to St. Paul. While a resident at the Falls Mr. Edmands won the esteem of all electricians, besides making numerous other friends, who very much regret his going to new fields.

The recent death of John M. Thatcher at Proctor, Vt., recalls the fact that with one exception he was the only person who ever rose from the grade of clerk in the Patent Office to the position of Commissioner of Patents. He was born at Barre, Vt., in 1836, and received a common school education, and finally graduated at the University of Vermont. He fought in the civil war, and at its close engaged in teaching. He received an appointment as a clerk in the Patent Office in 1864 and was assigned to duty in the examining corps. He seemed exactly suited to the business, and in less than 12 years he was at the head of the Patent Office as commissioner, passing through each one of the intermediate grades in turn. As commissioner his decisions evinced the most painstaking and thorough study of cases submitted to him. During the time he was in the Patent Office he studied law and was admitted to the bar in 1870. In 1875 he resigned the office of commissioner and has since been engaged in the practice of the law.

ELECTRIC LIGHTING.

From the evidence given in the case of the Lyons Electric Light & Power company against David Bastian, in the test case now on trial at Lyons, N. Y., it appears that the volume of water now carried by Canandaigua Outlet has been much reduced during the last 20 years. It is a matter of great importance to the plaintiff in this action as to whether the courts will permit the maintenance of the dam which the farmers tore away.

ELECTRIC RAILWAYS.

For the benefit of American manufacturers of electric railway apparatus, United States Consul Ashby at Dublin has reported to the State Department that the select committee of the House of Lords has passed the bill authorizing the construction of the Hill of Howth electric tramways. The bill was promoted by the Great Northern Railway company of Ireland. It is proposed to construct an electric tramway, starting at Sutton, situated on the Howth peninsula, extending around the Hill of Howth to the town of Howth, a distance of about 5½ miles, there to connect with the Great Northern line from Howth Junction to the town of Howth. It is also proposed to convert the Great Northern line from Sutton to Howth into an electric line, so as to give a complete circuit for the electric line. The estimated cost of the work is placed at about $200,000.

MISCELLANEOUS.

The Board of Penitentiary Commissioners (Alexander C. Hull, secretary), Little Rock, Ark., will receive sealed bids for the installation and erection of an electric light and power plant in that city up to noon, June 14th. Plans and specifications may be had by applying to either E. T. McConnell, superintendent of the penitentiary, or to the secretary of the Board of Penitentiary Commissioners, Little Rock, Ark.

On Wednesday, May 26th, Charles G. Burton of the Central Electric company of Chicago gave an interesting address before the Western Society of Engineers at the Technical Club, on "Facts Relative to the Discovery of the X ray." An audience in the neighborhood of two hundred people, including quite a number of ladies, was present, and Mr. Burton's very practical and comprehensive address excited favorable comment. Mr. Burton gave a detailed description of the apparatus for producing the X-ray, and followed his talk by an exhibition of his personal collection of X-ray lantern slides. After a presentation of the slides, Mr. Burton gave a practical exhibition of the method of handling X-ray apparatus and the use of the fluoroscope. The apparatus used to demonstrate the X-ray phenomena was of the latest and most improved type manufactured by Queen & Co. The coil employed produced a 12 inch spark, and was operated directly from 110 volt circuit in the building. As Mr. Burton has had considerable experience in the practical operation of X-ray apparatus, and has been making a collection of X-ray lantern slides from a most interesting line of subjects that have come to him from time to time, the entertainment proved of decided value to the well-posted technical audience.

TRADE NEWS.

The East Side Electric company, Detroit, Mich., owing to an increase in its business, has ordered from the Ball Engine company, Erie, Pa., a 150 horse power engine.

Morgan Brooks, the assignee of the firm of W. B. Hale & company of St. Paul, Minn., announces that on June 10th he will receive sealed bids at 396 Jackson street, St. Paul, for the electrical supplies, etc., and office fixtures of the insolvent firm.

The Interior Conduit & Insulation company of New York will have its usual corps of representatives at the convention at Niagara Falls. The company does not expect to make an exhibit, as its product is so well known that it considers it would not be necessary.

J. H. Cook, the Chicago representative for the Manhattan 150-hour arc lamp, reports fair business for the month of May. He says that there are many installations contemplated in the near future. A full line of arc lamp supplies may be found at the Chicago office.

Under date of May 26th the Crown Woven Wire Brush company of Salem, Mass., sends out this notice: "J. Orne Ryder has severed his connection with the Crown Woven Wire Brush company, and from this date will cease to hold the position of secretary and treasurer."

The Commercial Electrical Supply company of St. Louis has recently acquired agencies for the Fiberite company, the Keystone Electric Instrument company, F. H. Ayer (self-locking arc lamp windlass), and the Cutter Electrical & Manufacturing company (I-T-E circuit breaker).

Power station designers and users of machinery in general will find the new general catalogue of the Dodge Manufacturing company of much value. The varied power transmission appliances of this company are well known, and in the 288 pages of the catalogue they are clearly described and illustrated, and the prices are given. The company's main office is in Mishawaka, Ind., and in Chicago the Rice Machinery company of 166-174 South Clinton street is agent.

Merit and non-infringement are the great claims made for the telephone apparatus of the Stromberg-Carlson company of 74 Jackson boulevard, Chicago. This company has just issued a well prepared catalogue, in which it states its position with clearness. One excellent feature is a list of "Cautions" to intending telephone exchange investors, which is here quoted: "First—Incorporate your company; raise your capital; place the necessary funds in bank or in the hands of trustees, and get your franchise. Second—Obtain long-time contracts with your subscribers. Third—Employ a competent construction expert to locate your lines with a view to future business. Get his estimates of quantity and cost, erected, of all outside material, deciding at the same time on the system you will adopt, viz., whether common-return or strictly metallic. The latter is far superior to the former, and will pay for itself many times over, although its first cost is greater. Fourth—Investigate carefully the leading makes of telephone apparatus and subject samples thereof to the severest tests; inform yourself as to the experience of others; have your experts examine the construction, design and efficiency of this apparatus; do not permit first cost to stand in your way. The very best built, best talking, simplest mechanism is the only kind to have—first, last and all the time. Your troubles will be fewest and your subscribers' list the greatest. Fifth—When you have decided upon a particular make of apparatus, obtain your patent attorney's report as to infringement. Sixth—Close your deal with the manufacturers and employ a competent consulting electrical engineer to work out your system of line construction. The finest switchboard on the market is of no use if cross-talk, leakage, etc., result from poorly built leads. Seventh—Build your plant upon the above lines, and you will have a permanent, gilt-edged investment, if you employ a competent exchange manager to guard your interests."

BUSINESS.

In its catalogue the Willard Electric & Battery company of Cleveland, Ohio, sole manufacturer of the Willard accumulator, announces that its storage batteries do not infringe on others' patents, and that all customers will be protected against infringement suits. The plates and cells are described and illustrated.

The fan season may now be said to be fairly opened, and large business should be done during June and July. The Electric Appliance company is in the field with a large and complete fan catalogue, showing a full line of alternating and direct current desk, wall and ceiling fans. This catalogue will be valuable to every purchaser of electric fans of any kind.

The owners of the Claus Spreckles building, a new structure 19 stories high, at the corner of Third and Market streets, San Francisco, have recently awarded a contract for three 150 horse power vertical cross-compound engines, each of which is arranged for direct connection to a 100 kilowatt General Electric machine. The engines will be built by the Ball Engine company, Erie, Pa. This will be one of the most attractive plants of the city.

An interesting booklet is the one issued by the Best Telephone Manufacturing company of Baltimore, Md., entitled "How the Best Telephones Are Made," and

sbowing, by a series of views, the work done in the company's factories. The Best company appears to be making an energetic and successful campaign in the East. It does not hesitate to employ plain language. Addressing "the concern which, a few months ago, monopolized the telephone business in the United States," it says. "If they can produce and put in use a telephone as good as ours without infringing our patents, there will be hope for them yet, despite their heavy handicaps of royalties, watered capital, worn-out plants and popular disfavor."

The Columbia Incandescent Lamp company of St. Louis recently issued an interesting letter to the trade calling attention to the aggressive work that had been accomplished by this company in the matter of defeating those monopolistically inclined relative to the incandescent lamp market, and the company feels that its success in the suit referred to resulted in the great reduction in the price of incandescent lamps that followed, and hence has made a great saving to the lighting companies and all users of incandescent lamps. The letter further reminds the trade that recently suits have been brought on many detail patents covering different kinds of filaments and many detail methods which are essential in manufacture. The Columbia company states that after careful consideration of these patents it has concluded to take out a license under them and thus secure the company and its customers from further patent infringement and further patent litigation. The Columbia company feels that the wisdom of this policy is evidenced by a continuance and increase of its already good business. President J. H. Rhotehamel, who has been at the helm of this concern during the most troublesome times of the lamp business, is entitled to due credit for the Columbia company's present successful condition .It has always been his aim, to put it in a nutshell, "to carry the very best lamp at the very lowest possible price," and it has always been the effort of the experts of the company to so protect the process of manufacture as to produce filaments that would give the most uniform results in the matter of voltage and consumption of energy.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued May 25, 1897.

583,026. System of Telegraphy. Charles G. Burke, Brooklyn, N. Y. Application filed September 4, 1896.

The method of telegraphing consists in transmitting over a line electrical impulses of uniform duration at variable intervals, and indicating or recording at the receiving station the intervals between impulses or the periods of no current on the line.

583,039. Electric Signal Distributer. Pliny H. Fisk, North Branch, Minn. Application filed October 28, 1895.

Levers are actuated by electro-magnets and provided with contact-points; a laterally movable block having contact-plates in proximity to the contact point of the lever and adapted to alternately connect electrically therewith by the lateral movement of the blocks, block slidable upon the levers and having spring contact plates attached thereto, a series of slidable blocks upon fixed guides having contact plates separated by an inclined stop, against which the spring contact rests, and electrical connectioos, whereby when the levers are actuated its contact points will close a circuit through one of the contact plates on the laterally movable blocks, and hold it closed so long as the electric current is maintaioed through the electro-magnets which operate the levers, and the contact points of the levers be returned to their normal positions into electrical connection with the otber contact plates of the laterally movable block when the current is broken through the magnets, and whereby, also, a current shall be thrown through a second magnet to close a circuit through the contact plates upon the slidable blocks wheo tbey are brought into predetermined positions before the contact points upon the levers are returned to their normal positions.

583,060. Electric Arc Lamp. Frederick A. La Roche, New York, N. Y. Application filed December 22, 1896.

There is the combination of a diaphanous air-tight chamber inclosing the arc, and having two apertures in the wall of the chamber at opposite points, two carbon rods, one for each aperture, passing through and making close sliding contact with the wall thereof, a free and independently movable bushing for each aperture, a suitable clutch for each carbon rod, and means for affording universal movement to each clutch.

583,104. System of Generating and Using Hydrogen Gas and Electricity. Luther H. Wattles, Providence, R. I. Application filed December 7, 1895.

A gas engine and electric motor are connected to the same shaft, so that the system may be interchangeable.

583,109. Electric Race Horse Carousel. James W. Daniels, Paterson, N. J. Application filed October 28, 1896.

The feature of this device is the truck, having the electric motor attached to the rear axle, the figure or horse mounted upon the track, with a circuit-breaking mechanism or switch mounted in the mouth of the figure or horse, and adapted to be operated by means of the reins.

583,128. Galvanic Element. Paul Schmidt, Berlin, Germany. Application filed May 29, 1896.

A galvanic battery comprising an inner cylinder closed at its lower end and forming one electrode, the electrode cylinder closed at its top and fitting over the inner cylinder, so as to leave the upper end thereof open, and a space between the cylinders, the cylinders being seated at its lower edge about the inner cylinder, the cylinder about the electrode, the galvanic battery being adapted to be inverted and containing an electrolyte within the cylinders.

583,132. Primary Battery. Henry M. Sutton and Walter L. Steele, Dallas, Tex. Application filed March 17, 1896.

A feature of the battery is an independent metallic supporting ring encircling the lower end of the porous cup and provided with a peripheral series of supporting feet resting on the bottom of the cell, and an annular rest-groove in its upper face to receive the lower end of the zinc cylinder, a conductor rod having a connection with the supporting ring and extending above the top of the cell, and a detachable plug passing through the cover and engaging with the upper end of the conductor rod.

583,142. Telephone Receiver Support. Luis Duque and Francis M. Cosgrove, San Francisco, Cal. Application filed September 15, 1896.

A telephone receiver support comprises an offstanding supporting rod having a threaded outer up extremity, and an oblong holding cage or basket provided at diametrically opposite sides with fixedly positioned interiorly threaded sockets disposed reversely to each other and at an angle to the transverse center of the cage or basket.

583,178. Underground Electro-magnetic Railway System. Joseph Hoffman, Schenectady, N. Y. Application filed May 13, 1896.

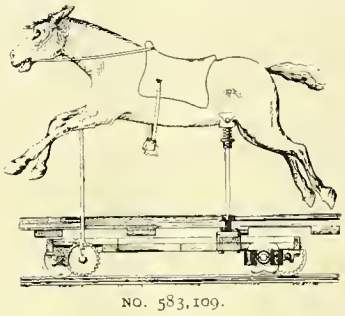
The combination is described with a feeding wire and a contact-rail, of separated contact-boxes which act as supports for but are insulated from the contact rail, a movable electro-magnetic contact device within the box or casing adapted to make contact with the rail, and a flexible conductor rigidly attached at one end to the feeding wire, and at the other to the movable contact device.

583,210. Electric Motor. Joseph Connor, James R. McMillan and Allen J. Fuller, Philadelphia, Pa. Application filed September 26, 1896.

Features of construction are: An armature, a shaft carrying the armature, a frame supporting the shaft, a box carried by the frame inclosing the armature, a removable cover for the box, one of the ends of which is bent up and back forming a hook, a staple carried by the box adapted to engage and hold the hook, a lug upon the opposite end of the cover, a keeper pivoted to the box, and a screw-bolt carried by the keeper adapted to engage the lug.

583,213 Electric Warp Stop Motion for Looms. Richard J. Mommers, Manchester, Conn. Application filed August 31, 1896.

There is in a loom a shipper-handle, means to hold it in position to maintain the loom in operation, a knock-off lever provided with an armature pivoted thereon, and an electro-magnet also mounted on the knock off lever and arranged in an electric circuit, which when excited moves the armature into its abnormal position, combined with means to meet the armature and move it, and the knock-off lever to release the shipper-handle, and means to effect the closure of the circuit.

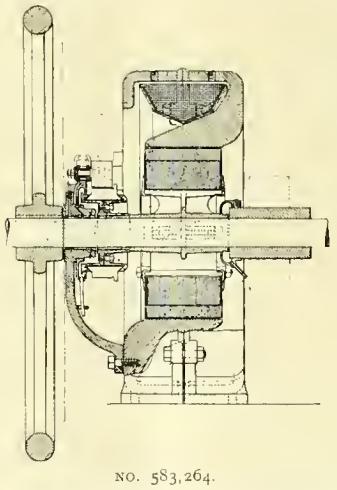


NO. 583,109.

583,214. Electric Warp Stop Motion for Looms. Richard J. Mommers, Manchester, Conn. Application field August 31, 1896.

A drop device is employed, freely suspended from a warp thread; also stopping mechanism for the loom, an electric circuit including the drop device and the stopping mechanism, two bars, one of which is in the circuit, one of the bars being yieldingly movable toward the other bar to press the drop device between the two bars, thereby to complete the circuit and operate the stopping mechanism, and means to operate the movable bar.

583,249. Electric Furnace and Method of Operating Same. Alfred H. Cowles, Cleveland, Ohio. Application filed July 6, 1895.



NO. 583,264.

The electric furnace chamber has electrical connections for the passage of an electric current through it, pipes are connected therewith for the inflow and outflow of gases, a reversing valve in operative relation to the pipes to reverse the flow of gas through the electrically heated field, and an air-pipe connected with the gas-supply pipe outside of the reversing valve.

583,250. Electric Furnace. Alfred H. Cowles, Cleveland, Ohio. Application filed July 6, 1895.

An electric circuit is connected with the chamber, and adapted to produce a zone or area of electric heat, separate gas inlet and outlet passages are connected with the chamber, and means for periodically reversing the flow of gas therethrough are also provided.

583,255. Catbode for Electrolysis. Ernest Auguste Georges (called Charles) Street, Paris, France. Application filed June 13, 1896.

A cathode for the electrolysis of bodies which produce solid deposits on the negative electrodes, characterized by a contractibility in dimensions when the deposit has formed thereon, so that the deposit may peel off and be removed with the greatest facility, the cathode being constituted for this purpose by a thin sheet, preferably of metal, wound once or oftener upon itself, and the contraction in the dimensions being obtained after the formation of the deposit.

583,264. Electric Motor or Dynamo-electric Machine. Robert Lundell, Brooklyn, N. Y. Application filed December 15, 1896.

An electric motor having a field magnet composed of two duplicate cylindrical inclosing magnetic shells, having inwardly projecting wedge-shaped pole-pieces and legs or supports, all cast integral, in combination with a single field magnet coil which fills the entire space made by the united shells and the inwardly projecting pole-pieces.

583,273. Series Multiple Controller. Thorsten von Zweigbergk, Cleveland, Ohio. Application filed January 21, 1897.

Combined in this arrangement are two motors, two contact fingers, one of which is connected with the two motors in series, and one with the two motors in multiple arc, a switch movable in both directions from the shut-off positioo, and means for connecting one finger with the trolley when the switch is moved in one direction, and for connecting the finger with the ground and the other finger with the trolley when the switch is moved in the opposite directioo.

583,309. Bond for Electric Railways. James McLaughlin, Chicago, Ill. Application filed October 19, 1896.

There are terminal heads and a pin or key held permanently in the terminal head by casting or forming the head about the key or pin, and means for expanding and locking the head by driving the pin or key.

583,316. Electric Lamp Hanger. William S. Weston, Chicago, Ill. Application filed August 8, 1896.

One claim is given: In an electric lamp hanger, the combination with a hanger-board, conductor cables, a rotary drum and hand-rope, of a movable frame upon which the drum is journaled, a flexible frictioo-brake attached at one end to the hanger-board and at the other to the movable frame, and a forked hook or clamping device having tapering or wedging prongs or jaws, between the prongs of which the hand-rope passes.

583,323. Method of and Apparatus for Charging Storage Batteries. Clarence C. Bramwell, Hyde Park, Mass. Application filed August 22, 1895.

The number of cells in the charging circuit is in direct proportion to the strength of the current.

583,324. Current Collecting Device for Electric Railways. William M. Brown, Johnston, Pa. Application filed July 18, 1896.

An electrically propelled vehicle, a magnet carried thereby, and having two longitudinal parallel poles, a longitudinal flexible member secured to each pole, and means for adjusting the position of the member.

583,330. Process of Electrolysis. Ernest A. Le Sueur, Ottawa, Canada. Application filed April 5, 1892. Patented in England September 5, 1891.

The improvement in the process of decomposing the chlorides of sodium and potassium by electrolysis described consists first in establisbing electric action through the electrolyte, and secondly in maintaining the salt solution in the anode compartment in the chemical condition in which such solution exists at the commencement of the action by adding to the contents of the compartment hydrochloric acid to combine with the hydrate that leaks or diffuses through the diaphragm from the cathode compartment, and form therewith solution of chloride of sodium or potassium.

583,411. Machine for Fastening Hangers in Electric Wire Cables. Willbur H. Johnston, St. Louis, Mo., and Samuel B. Fowler, Chicago, Ill. Application filed July 18, 1896.

A machine for securing hangers to electric cables consists of a main framework, supporting thereon a device consisting of a pair of jaws, and means for operating the same, the jaws adapted when operated to embrace the cable with a banger, a marking-wheel on the framework, and a series of pulleys at either end of the framework adapted to hold the cable straight while passing through the jaws.

583,418. Telegraphy. Oliver R. Roberson, Glen Ridge, N J. Application filed August 24, 1896.

An alternating current dynamo is placed at a transmitting station; also two transmitting keys, a main line, two receiving devices at the receiving station, and collector segments and earth connections for directing over the main line a series of positive pulses produced by the dynamo for transmitting one message, and a series of negative pulses produced thereby for transmitting a second message.

583,423. Electric Signaling Apparatus. Alden D. Wheeler, Hyde Park, Mass. Application filed February 2, 1897.

The inventor claims a number of normally closed box-circuits, each having box-number circuit controllers, a normally open circuit multiple pen recording instrument connected therewith, shunt switches for the peo magnets of the recording instrument, means for opening all of the shunt switches upon the occurrence of the first impulse of any one of the box-number circuit controllers, to thereby include the recording instrument in circuit with all of the box-circuits.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, JUNE 12, 1897. No. 24

Niagara Falls as an Electrical Center.

By Orrin E. Dunlap.

One who is well versed in the history of the Niagara locality has written: "Just when white men first saw the falls we cannot accurately say," but he continues, and adds, "the commencement of what may be termed the modern history of this region dates back to that day in December, 1678, when, starting from the mouth of the Niagara River,

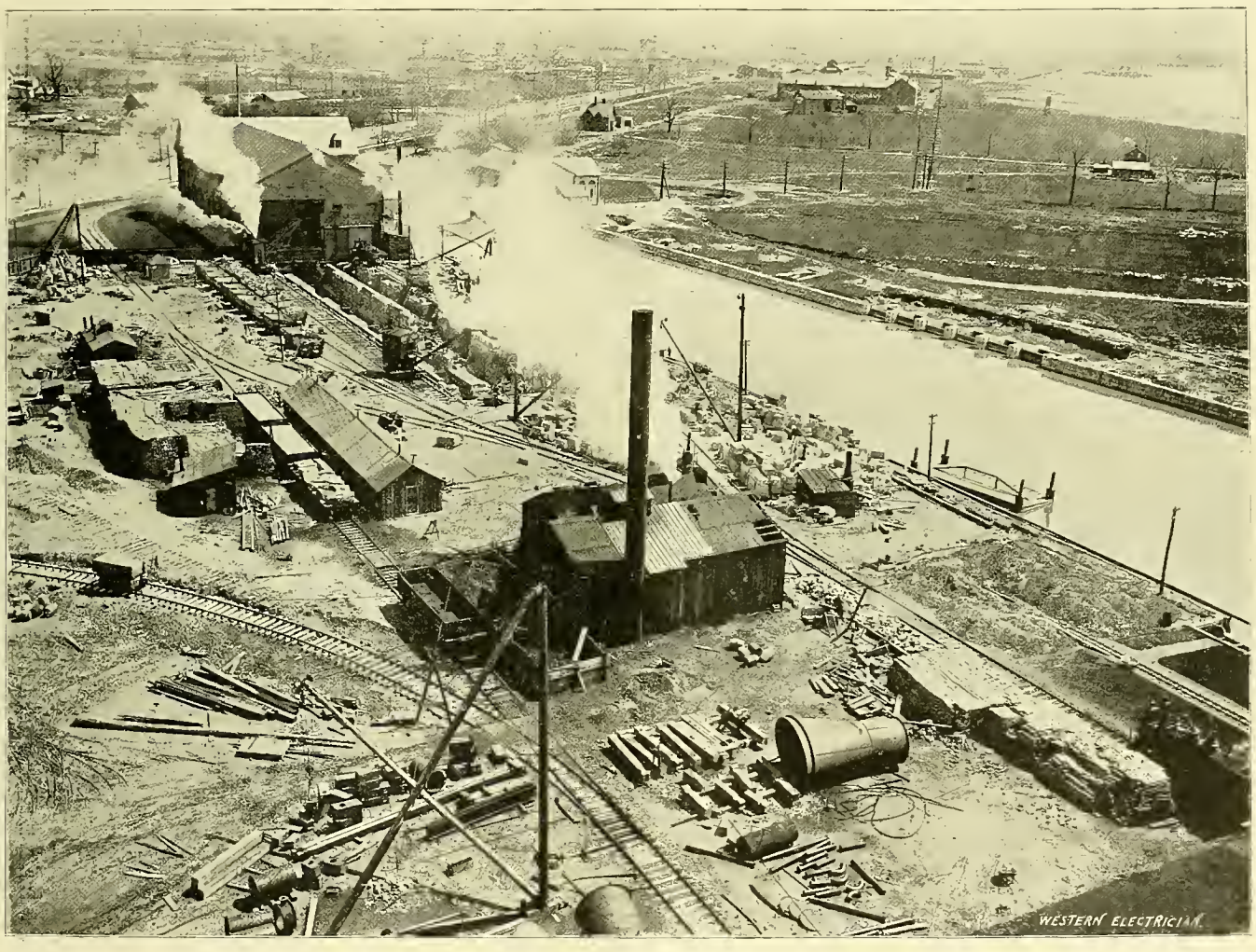
A chieftain of the Iroquois, clad in a bison skin,
Had led two travelers through the woods—
La Salle and Hennepin.

For 100 years the nations represented by these men controlled the destinies of the locality, but they in turn gave way to a stronger race, which acquired possession of the territory and has ever since been active in its development. For many years men sorrowfully looked upon the immense quantity of water "going to waste" over the falls, and longed for a plan that would force it to contribute to their welfare. The very stupendousness of this idea awed many, for they did not think that such wild water could be made to submit and cater to humanity. Brilliant engineering talent has, however, accomplished this, and now Niagara, "the Thunder of Waters," is herself sounding the rejoicings over the notable accomplishment.

The coming of La Salle and Hennepin to Niagara marked the advancement of civilization. The history of Niagara for years following the visits of these famous explorers, is best told in the world-wide reputation Niagara has to-day for its wonderful sublimity and beauty. More than two centuries after La Salle and Hennepin had left their footprints on the river bank, and Cornellis' map (in 1688) located the Falls and first used the name "Niagara," there came from the East other men—Adams, Stetson, Wickes, Rankine, Clark, Astor, Bowdoin, Lanier, Larocque, Mills, Whitridge—who represented sufficient capital to develop the power resources of the stream whose principal duty heretofore had been to brighten the eyes and gladden the hearts of admiring and curious visitors by its beauty and fierceness. Equally as certain as did the visits of La Salle and Hennepin, the coming of these men defined the entrance into a future destined to be wonderful. These later visitors came to the Falls with almost unlimited financial means at their command and backed by the discoveries scientists had made in the centuries that had rolled by since a white man's eyes had first looked upon the great waterfall. In addition to these facilities they were encouraged to stupendus feats by the never-ending demand made upon the power resources of the United States by the constantly increasing industrial development. Their coming marked the opening of the electrical era, which has so distinguished Niagara, while the work they have done denotes how eminently qualified were these men for the task they voluntarily selected to perform. Their accomplishments in the field of power development form a great portion of the very modern history of Niagara. When the National Electric Light association met in annual convention at Niagara Falls in August, 1889, this history was unwritten, and the first sod of the great work was unturned. All was then prophecy and hope—prophecy that a wonderful development of power was possible, and hope that many years would not pass ere the work would be undertaken. Since then page after page of numerous publications have portrayed in picture and word the advancement Niagara has made in the electrical field, until no doubt many of the members of the National Electric Light association have become imbued with a great desire to see and study for themselves the work that is being performed by mighty generators and powerful turbines influenced by the plunging, but controlled, waters of the Niagara.

That every opportunity will be afforded them for their inspection is well understood, and they will find courteous officials glad to extend them greeting, and welcome them to the Power City. It is probable that the greatest interest will center in the power stations of the Niagara Falls Power company and of the Niagara Falls Hydraulic Power & Manufacturing company. The picture on this page presents a bird's-eye view of the Niagara Falls Power company's lands. The photograph from which the illustration is reproduced was taken at an elevation of 160 feet. It shows the power house, wheel-pit extension, and the factories along the shore of the river in the distance. The inlet canal is also prominent. On page 326 is represented a bird's-eye view of the Niagara Falls Hydraulic Power & Manufacturing company's property up to date, showing the new aluminum works and all other points of interest in that locality.

It is in the station of the Niagara Falls Power company that the three Westinghouse 5,000 horse power generators are in operation, and it is here that the wheel-pit



NIAGARA FALLS AS AN ELECTRICAL CENTER.—BIRD'S-EYE VIEW OF THE NIAGARA FALLS POWER COMPANY'S PROPERTY.

is being extended to provide room for seven additional turbines to operate seven additional dynamos. It is also from this station that 1,000 horse power is being transmitted to Buffalo, and a visit to the transformer house adjoining the power station will be of interest. Of the remainder of the power at present generated in this great station the Pittsburg Reduction company gets 3,050 horse power; the Carborundum company, 1,000 horse power; the Acetylene Light, Heat & Power company, 1,075 horse power; the Buffalo and Niagara Falls Electric Light & Power company, 500 horse power for local lighting; the Niagara Electro-chemical company, 400 horse power; the Buffalo & Niagara Falls Electric Railway company, 250 horse power; the Niagara Falls & Suspension Bridge Street Railway company, 250 horse power; the Walton Ferguson Chemical Construction company, 500 horse power; the Hygeia Ice company 40 horse power, while the Mathieson Alkali company and the Albright & Wilson company, limited, will soon be ready to have the current turned into their factories. From this it will be seen that the resources of the present installation are pretty well exhausted, and that there is every incentive to enforce the early completion of the power house and wheel-pit extensions in order that more power may be obtained. Buffalo has already contracted for several thousand horse power in addition to what it is now receiving, and the Niagara Falls Power company is doing the best it can to give the Buffalo industries all they want at an early date.

The fact of the transmission of Niagara power to Buffalo and the heating of the power station of the Niagara Falls Power company by electricity should prove incidents of no little importance to the members of the National Electric Light association, for the reason that when they met at the Falls in convention on August 6, 1889, they were addressed by the Hon. W. Caryl Ely, who, in the course of his remarks, prophesied that the time was coming when the falls of various streams would be "harnessed" and the power transmitted to near-by cities and towns. At that time the development of water powers was not so general as it is to-day, and Mr. Ely's hopeful remarks were applauded as the advance herald of the good times coming. He also predicted that in years to come Niagara energy would be sent out in great trainloads in storage batteries, and his hearers listened with rapt attention and in imagination pictured the rails of the great roads busy with this freight. The station of the Niagara Falls Power company is the largest building in the world heated electrically, and for all the National Electric Light association comes to the Falls at a time of year when artificial heat is hardly necessary for comfort, the members should find in the electrical heating of this handsome building one of the most encouraging features of the progress of their profession, for it was while in convention in the old Park Theater at Niagara Falls in 1889 that they amended their constitution so as to make the application and study of electricity for light, heat and power the object of their existence. This was done by the addition of the word "heat," and the writer well recalls how some of the members felt that such application would be a little out of their field. Those were hopeful days, and the possibilities of development on all sides at Niagara seemed to fill all present at the convention with enthusiasm and a general feeling that they were entering a new era. How that era has developed the members of the National Electric Light association well know, but while at Niagara they will see much that will impress them with the conviction that no industry has made greater progress within such a short time. In this condition there is much that is very gratifying.

A visit to and an inspection of the power station of the Niagara Falls Hydraulic Power & Manufacturing company, controlled by Messrs. Schoellkopfs, will reveal to the visitor an entirely different method of developing Niagara power than that found in the station of the Niagara Falls Power company. This power house is located at the water's edge, and is reached by means of an elevator in the Cliff Paper company's plant. In this station are installed four turbines made by the James Leffel company of Springfield, Ohio, three of which operate six generators, the power product of which is used by the Pittsburg Reduction company, while the fourth Leffel turbine operates two generators which supply power for the operation of the Niagara Falls & Lewiston railway and also the Lewiston & Youngstown railway. It is in this station that aluminum cables are used to conduct the power up to the aluminum works situated on the high bank above. Two cables are used, each cable having 250 strands, and they have been found very efficient. In this station also is to be seen the application of a second generator as a "booster," used in supplying the Lewiston & Youngstown railroad with power, the transmission being about 15 miles. While at the foot of the elevator it may be well to take a look into the Cliff Paper company's electric station. This company was the first to apply electricity to papermaking, and it has two generators direct-connected to a turbine made by the James Leffel & Company. The motors are in the mill at the top of the high bank. The electric power of the Niagara Falls Hydraulic Power & Manufacturing company is disposed of as follows: Pittsburg Reduction company, 3,500 horse power; Niagara Falls & Lewiston railroad, 500 horse power; Cliff Paper company, 300 horse power; Lewiston & Youngstown railroad, 200 horse power; Buffalo & Niagara Falls Electric Light & Power company, 350 horse power; Niagara Falls Brewing company, 150 horse power; Rodwell Manufacturing company, 75 horse power; Francis Hook & Eye company, 15 horse power; Kelly & McBean company, 15 horse power; other small customers, 100 horse power—making in all 5,205 horse power. Frank G. Lott is the electrical superintendent and Wallace C. Johnson the engineer of the Niagara Falls Hydraulic Power & Manufacturing company, and they will be pleased to afford every facility to members of the National Electric Light association for inspecting all parts of the power installation.

The operation of the trolley lines by power generated in the great power stations will no doubt prove of interest to all. All the lines of the Niagara Falls & Suspension Bridge Railway company and the Buffalo & Niagara Falls electric line are operated by power furnished by the Niagara Falls Power company, while the "gorge road" and the Lewiston & Youngstown road are supplied with power by the Niagara Falls Hydraulic Power & Manufacturing company. A trip over the "gorge road" will convince all that electricity has been and is a great incentive to wondrous undertakings.

In the main station of the Buffalo and Niagara Falls Electric Light & Power company's plant, located almost directly opposite the Niagara Falls Power company's power house, the members of the National Electric Light association will find a model station. Frank G. Lott is the manager, and he extends a cordial invitation to all to visit the plant. The power for the operation of the station is supplied by the Niagara Falls Power company, and is applied through 300 horse power motors.

NIAGARA FALLS AS AN ELECTRICAL CENTER.—BIRD'S-EYE VIEW OF THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY'S PROPERTY.

One of the things that must impress all electricians is the growth Niagara Falls has made as a chemical center. It would seem that the prediction made years ago, that the chemical industries would gather about the place of cheap electrical power, is about to be fulfilled. In the new factories at Niagara Falls that are open to inspection will be found much that is instructive and entertaining. The furnaces of the Carborundum company stand unequaled as power consumers, and their product has attained a world-wide reputation. In the plant of the Acetylene Light, Heat & Power company furnaces of different style but equally interesting will be found, while the new factories in course of erection are but an intimation of more to come. In the extensions of both power plants now under way will be found ample assurance that the development of Niagara power has passed the experimental stages, and that the men who have invested in the projects are well satisfied with their investments. This one fact speaks worlds for the future of Niagara as a power center, and should as many years again elapse before the National Electric Light association selects Niagara Falls as a convention place, it is highly probable that progress as well defined as that found to-day will be there to entertain and interest them. It is significant of Niagara's growth that during the period of time Niagara has made this notable advancement the financial world has several times been almost on the verge of panic, but despite this Niagara has

forged steadily ahead. With a general return of prosperity to the industrial world, it is hard to predict what would be Niagara's growth within the next decade. It is altogether likely, however, that men of the electrical science will always find much that is new at Niagara Falls.

In the retention of many broad acres of land by the Niagara Falls Power company, and in the building of the industrial suburb of Echota, members of the National Electric Light association will find displayed the wisdom of the men who are back of the greatest power development the world knows of. Many thousands of dollars have been expended in improvements outside of the field of power development, so that the locality might be well representative of the project which has attracted so much attention. Over on the Canadian side in Queen Victoria Free Park will be found the point where a start has been made in developing power on that side of the river. It has been pointed out that the method of development would be very similar to that employed on the New York state side, but the spot will be well worth remembering, for in time another great power-producing plant will be installed there, thus adding to Niagara's reputation for immensity in power matters.

An inspection of the several installations referred to will be found replete with pleasure, while glimpses of the natural beauty of the locality of the Falls will add materially to the delights of the Niagara convention, making it memorable to all.

President Nicholls' Administration.

It has been a great many years since the National Electric Light association has had such an energetic president as the occupant of the office at this time, and it is but fitting in the closing days of his administration to call attention to the excellent character of the work he has done and the value of the service he has contributed to the association. President Nicholls has probably given more of his time, and has made greater sacrifices of personal comfort and private interests in doing so, than any former occupant of that position. There were many disadvantages to be overcome in his case, which did

FREDERIC NICHOLLS, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

not generally obtain. The question of residence, for instance, was one of considerable importance in this case, but it must be said to President Nicholls' credit that had he been a resident of New York he could not have given closer attention to the discharge of the duties of his office than he did, hampered as he was by having the headquarters at a considerable distance from his home.

The numerous topics that have occupied the attention of the organization and the fraternity since the last meeting of the association are too well known to require enumeration here. It is enough to say that those affecting the interest of central station men have received the careful attention of President Nicholls. It has been said that his administration would be remembered as the one in which the president as an official took an active part in the events of the day. While the inference naturally drawn from this may not be exactly fair to those who have occupied the office before, it is true, however, in so far as it relates to public and official expression of opinion upon matters under consideration. President Nicholls may in later days be credited for having introduced the custom of addressing messages *ad interim* to members of the association upon subjects under consideration. It must be admitted, too, that this practice has its advantages, not the least of which is to keep alive interest in the organization and its work between meetings.

Frank G. Lott.

One of the men whom the members of the National Electric Light association will meet at Niagara Falls is Frank G. Lott, whose picture is herewith presented. Although Mr. Lott is only 34 years old, he occupies the responsible position of manager of the Buffalo & Niagara Falls Electric Light & Power company, and also superintendent of the electrical department of the Niagara Falls Hydraulic Power & Manufacturing company. He has his office in the International Hotel, where the convention meets. Mr. Lott began his electrical career with the old Fuller Wood Manufacturing company in 1881. He has installed electrical plants in England and Sweden for the American Manufacturing company, which is now out of business. Later he was engineer of the Buffalo Cyclorama company in London, Eng., for four years. In 1895 he located at Niagara Falls and engaged with the Niagara Falls Hydraulic Power & Manufacturing company, and in October, 1896, when the Buffalo & Niagara Falls Electric Light & Power company and the Niagara Falls Hydraulic Power & Manufacturing company came to a business understanding, Mr. Lott was made manager of the first named company. Since taking charge of the station he has brought it up to the modern standard, and to-day it is quite a model in its way.

National Electric Light Association.

This year's convention of the National Electric Light association is the twentieth meeting of that body. The organization has grown in membership; its influence has been greatly extended, and it is now in better condition to do the work for which it was organized than ever before. At this year's meeting there will be a departure from the custom that has heretofore prevailed. There will be no general exhibition of apparatus, although there will be many excellent and highly interesting displays made by individual members and companies in the hotels. There will, however, be the usual representation of manufacturing and supply companies, and there is no fear that the attendance will suffer. In fact, it is believed that the many attractions for electrical men at the Falls will bring together the largest number of central station managers that have ever attended a convention of this association, and where the central station man is found the manufacturer and dealer in supplies may be expected to be represented.

The programme for the meeting was published in the WESTERN ELECTRICIAN, May 29th, but it may not be amiss to call attention to some of the features of special merit. Among the papers to be read before the convention are the following:

"Standardizing Prices for Incandescent Light and Power," by J. B. Cahoon.
"Municipal Lighting," by W. Worth Bean.
"Correct Method of Charging for Product," by C. L. Edgar.
"The Niagara Power Transmission Line," by J. G. White.
"Profitable Extensions of Electrical Supply Stations," by Arthur Wright.
"The Induction Factor, a New Basis of Dynamo Calculation and Classification," by Prof. Charles A. Carus-Wilson.
"Recent Progress in Arc Lighting," by Prof. Elihu Thomson.
"The Daylight Work of Central Stations," by T. C. Martin.
"Niagara Power," by L. B. Stillwell.
"Polyphase Motors," by B. F. Lamme.
"Frequency Transformation," by Lieut. F. Jarvis Patten.
"Rotaries for Transforming Alternating into Direct Current," by C. F. Scott.

A glance over this list of papers and the names of their authors is alone sufficient to convince anyone familiar with electrical matters that the meeting should be one of the best in the history of the association. In addition to these contributions arrangements have been made for the general discussion of several subjects of pressing importance at this time. According to the programme there are also several reports of committees to be presented at the opening session, which should interest central station men. One of these is upon "Standard Candle-Power of Incandescent Lamps," by Dr. Louis Bell; another on "Data," by H. M. Swetland, and third on "Rules for Safe Wiring," by William Brophy. All of these are subjects of the first importance and the reports should receive careful attention.

It is scarcely necessary to dwell upon the social features and the provision that has been made for the entertainment of members and visitors. There are so many points of interest about the Falls that the only trouble will be that many will find it impossible to visit them in the limited time at their command. Special rates have been secured for members who desire to visit the principal points of interest, and no doubt many will avail themselves of the opportunity afforded by the association's excursion.

Convention Announcements.

Association headquarters have been established at the International Hotel and the convention hall will be in the same building.

The Keystone Electrical Instrument company of Philadelphia has selected Parlor E, Cataract House, Niagara Falls, for its convention headquarters, and will

FRANK G. LOTT.

have representatives present to explain the merits of its instruments and entertain its friends and patrons in its usual thorough manner.

Samuel Insull, president, and Louis A. Ferguson, general superintendent of the Chicago Edison company, will represent that company at the Niagara meeting.

The WESTERN ELECTRICIAN will be represented at the convention by W. A. Kreidler, W. Forman Collins and F. L. Perry of Chicago and W. F. Osborne of New York. The headquarters will be at the International Hotel.

Like many other concerns this year, the Interior Conduit & Insulation company of New York will depend upon personal solicitation, and for this reason it will have its usual corps of representatives at the convention at Niagara Falls. The company does not expect to make an exhibit, as its product is so well known that it considers it would not be necessary.

General Manager Gordon J. Scott of the Scott & Janney Electric & Manufacturing company of Philadelphia regrets his inability to be present at the convention, because of pressing business which will keep him at home. His company is preparing a vigorous defense in suits recently brought by the General Electric, Westinghouse and other companies for alleged infringement of patents.

Many members of the National Electric Light association no doubt will be interested in learning the extent of the arrangements that have been made for the forthcoming meeting of the American Street Railway association at the Falls. A visit to the old armory, which is now being remodeled into a convention hall and exhibition building, will give them some idea of the character and scope of the meeting. Intending exhibitors might take occasion to select desirable localities for exhibition purposes.

Henry L. Doherty, general manager of the Madison Gas & Electric company of Madison, Wis., will represent his company at the Niagara meeting. This will be Mr. Doherty's first appearance at a convention of the National Electric Light association, but not by any means his first experience in assemblies of a similar character. He has been prominently identified with several gas organizations, and of late has contributed largely to the success of the Northwestern Electrical association, of which he is a valued member. His efforts have been specially directed toward the opposition of the idea of municipal ownership, and he will doubtless be able to give the Eastern members a good account of the work that is being conducted throughout the West in this department, particularly by the Northwestern association.

Electrical Equipment of a Model Commercial Building.

Advancement in the application of electricity has made possible many architectural triumphs and added greatly to the comfort and convenience of the great modern commercial buildings in the large cities of the country. A practical demonstration of what can be done to-day, when the architect and electrical engineer co-operate, is afforded in the electrical equipment of the Silversmiths' building, recently erected in Chicago. This structure is located in the heart of the down-town

FIG. 1. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—EXTERIOR VIEW OF SILVERSMITHS' BUILDING.

business center of the city, on Wabash avenue near Madison street, which may be said to be one of the busiest retail districts of the world. It is divided into offices, salesrooms and light manufacturing establishments, but the casual visitor would undoubtedly class it among the most exclusive office buildings of Chicago. This impression is certainly warranted by appearances, for in construction, appointment, service and maintenance it ranks among the best buildings in the city. As the name indicates, it is the home of the leading silversmiths of Chicago. The Silversmiths' Building company, which owns the property, includes Edward Holbrook and George H. Robinson, president and vice-president of the Gorham Manufacturing company of New York, and Benjamin Allen and Otto Young of Chicago.

It may be said that such a building in the location selected for such purposes as the Silversmiths' is employed would not be among the possibilities a few years ago, and to-day the conditions that make it possible are obtained only through the improvements and refinements that have been gradually introduced and developed in construction and electrical engineering. The problem that confronted the owners of the property at the start was the determination of what would be the most practicable and economical method of supplying power for the building service and for the use of tenants. The architects and engineers of course pointed out that electric motors could be installed throughout the building wherever power was required by tenants, and that electricity could be utilized in the operation of the elevators, house pump, ejectors and ventilating system, if desired. Of course it was desired to light the building by electricity, and this left but one service to be otherwise performed, that of heating. It was proposed to obviate the necessity of installing a generating plant and large steam plant by placing all the electric service upon the central-station system of the Chicago Edison company, and burning natural gas under the boilers of the heating plant. This arrangement, it was pointed out, would reduce the labor item to a minimum, greatly lessen the investment for equipment and would ensure the company that its running expenses would not exceed a certain figure estimated by the companies furnishing the service. All of these considerations entered into the final disposition of the question, no doubt, but the feature that commended itself particularly to the owners was the absence of a power generating plant in the building, thus obviating the handling of coal and ashes and doing away with smoke, dirt and noise in all parts of the building.

The building is a modern steel structure with a terra cotta front, 10 stories high, having an elevation of 148 feet from the sidewalk. It has a frontage of 80 feet on Wabash avenue and extends back 160 feet. An excellent exterior view is presented in Fig. 1, from which some idea of its imposing appearance may be gained.

The ground floor is occupied by stores, and the entrance to the upper floors is at the north end, near Madison street. An indication of the character of the building is found in the artistic lighting fixtures, the ornamental hardware and the general surroundings that attract the visitor's notice on every floor. A picture of one of the electrical fixtures at the main entrance is given in Fig. 2. The favorable impression created upon entering is confirmed by an inspection of the upper portion of the building. The fifth, sixth and seventh floors are occupied principally by the salesrooms of Benjamin Alleo & Co., the Gorham Manufacturing company

FIG. 2. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—LIGHTING FIXTURE IN MAIN ENTRANCE.

and F. A. Hardy. A view of the Gorham company's headquarters is presented in Fig. 3, and this may be taken as typical of the class of establishments that is located here. It may be well to note that on each of these floors, in connection with the establishments mentioned, there are workshops in which power is employed. These, of course, are separated from the salesrooms and offices, and visitors see no indication of their presence. The absence of noise, smoke, dirt and disagreeable odors generally attending moving machinery is indeed striking and cannot fail to impress anyone familiar with the character of the many and varied enterprises that are conducted in this building. The use of electric motors has done more than anything else to make this possible, and, in fact, to enable the owners to erect a building of this character in the heart of Chicago. Such a combination of interests as is effected in this building would of course be out of the question if a steam plant, shafting and belting were necessary for supplying power.

Probably the most interesting feature of the electrical equipment is the elevator service. As originally designed, the plans called for hydraulic elevators, but many considerations influenced the owners in abandoning this idea and substituting electric elevators. This was considered an important victory for the latter, as the matter was carefully investigated in all its bearings and finally resolved itself into a question of cost of operation. This was met by the Chicago Edison company, which demonstrated to the satisfaction of the owners of the building the economy, adaptability and efficiency of electric elevators for the requirements of this service. Many other questions had to be solved, one of which was the method of operating the house pump and ejectors in the basement. In this, as in all other points, the advantages of electricity were demonstrated, and it was accordingly determined to drive this machinery by electric motors. This gave the central station a complete victory, and the engineers of the Chicago Edison company proceeded to take advantage of the opportunity and, with the co-operation of the architects and owners, install a model equipment for a modern commercial building. The result accomplished is eminently satisfactory. The data here presented are taken from the records of the actual performances of the plant, and as the figures can be verified for comparison with the records of other plants constructed for similar service, they should prove valuable and interesting to those who are studying the problem of the relative merits of central-station service and isolated plants.

The building is wired for 2,000 incandescent lights. 164 of which are distributed through the halls, basement, closets, etc., and the remainder are on the tenants' meters. Simplex wire is used throughout. The average cost per month of all the lights for the halls, etc., is $40.

The average power for operating the house pump and driving the air compressors for ejectors is 286,000 watt-hours per month, which is less than 1½ horse power for 10 hours per day, counting 26 days each month. The cost of the current for this work is $12 per month.

The elevator equipment comprises three machines for passenger service and one for freight. The former are, of course, conveniently arranged near the main entrance to the building, on Wabash avenue, and the latter is in the rear. They were furnished by the Crane Elevator company, and are operated by 25 horse power motors, especially designed for this service by the Gibbs Electric company of Milwaukee, and adopted by the Crane company as the standard equipment for its electric elevators. The freight elevator motor is of the same general design as that of the passenger elevator, with some modifications for the special requirements of this service. The passenger elevators are geared to operate at a speed of 250 to 333 feet per minute, and the maximum load provided for on each car is 2,500 pounds. The freight elevator is built for carrying 5,000 pounds, at a speed of 100 feet per minute. All the elevators are over-counterbalanced for the average load, that for the passenger elevators being estimated at 900 pounds. The passenger elevators are operated on schedule, one making 275 trips per day, the other two making 225 trips each. A record of the performance of the freight elevator shows that it averages 100 trips daily. The average consumption of power by the passenger elevators is 600,000 watt-hours per month for each elevator. This is practically an average of three horse power, 10 hours per day, counting 26

FIG. 3 ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—VIEW OF GORHAM COMPANY'S SALESROOM.

days per month for operation. The average consumption of power by the freight elevator is 277,000 watt hours per month, which is practically an average of 1½ horse power for 10 hours per day and 26 days per month. The cost of operating these four elevators since the building was completed will average $90 per month. The report of the architects on the test of these elevators shows an efficiency of 51 per cent.

In the general service plant for the building may be included the elevator equipments, the house pump and the ejectors, all of which are electrically operated, and the heating plant, the principal feature of which is that natural gas is used instead of coal. All of these are

represented in the accompanying illustrations, Fig. 4 showing the passenger elevator equipments in the front basement, Fig. 5 the freight elevator equipment in the rear of the building and the house pump operated by a three horse power Crocker-Wheeler motor, Fig. 6 the two Shone ejectors, each driven by a one horse power Crocker-Wheeler motor, and Fig. 7 the steam plant. The house pump is a Blake triplex machine having a capacity of 1,400 gallons and being automatically controlled by means of a Whittingham switch which is governed by a float in the tank after the usual method. In somewhat similar manner the government of the ejectors is effected. The basement is below the city drainage, and, as is customary in such cases provision was made for forcing the sewage into the city sewers. Two large receptacles, each having a capacity of 50 gallons per minute were constructed. Into these the sewage is drained. When they are filled an air check opens a valve and the Whittingham switches automatically close, thus starting the motors which drive the ejectors, and the sewage is forced into the city sewers. This arrangement is of course admirably adapted for the service and has proved both economical and reliable.

Distinguished from what may be termed the public service, or that which pertains to the entire building, are the individual power equipments which are maintained and operated for the tenants themselves. For instance, on the fifth floor is a small printing office conducted by Benjamin Allen & Co. as a department of their large establishment. In this plant a three horse power Eddy motor is used to drive printing presses, as shown in the cut, Fig. 8. On the floor above, the electroplating works of C. A. Allen are located in the rear of the Gorham Manufacturing company's salesrooms and offices. Here three motors are installed, one five and one three horse power Gibbs motors and one two horse power Eddy machine. A view of this establishment is presented in Fig. 9. Probably the most interesting workshop in the building is that of F. A. Hardy, the optician. The salesrooms and offices in the front are elaborately fitted up, and the rear is occupied by a workshop, a corner of which is shown in Fig. 10. A 12 kilowatt bipolar Edison motor furnishes power for operating grinding and polishing machines. Here as elsewhere throughout the building there is an absence of noise, dirt and other disagreeable features that are usually found in steam power plants.

It is in the boiler room, however, that this feature is particularly noticeable. In point of cleanliness and freedom from noise and obnoxious odors it compares favorably with any part of the building. It may be said, in addition to these advantages, that this steam plant in efficiency, economy and reliability ranks among the very best examples of modern practice in Chicago. The building contains 125,000 square feet of heating surface. The overhead low-pressure system is employed, the maximum pressure being two pounds. During the extreme cold weather of last winter no trouble whatever was experienced in heating the building by this system, and this was accepted by the owners as a satisfactory test of the efficiency of the plant.

It will be readily understood that the item of labor in a building of this kind is reduced to a minimum. Only two men are employed to look after the steam plant, elevator equipments, power machinery of all kinds, beside the lighting of the building, and to make such improvements and changes as may be demanded from time to time.

The architects for the building were D. H. Burnham & Co. of Chicago. The plans and specifications for the lighting and power service, the heating and ventilating systems and the construction and operation of the elevators were prepared by Charles M. Wilkes, the mechanical engineer of that firm, and the installation of the apparatus mentioned was under his personal supervision. Mr. Wilkes is very much pleased with the economical performance of the electric elevators in this plant and with the showing made by other parts of the system.

In conclusion it may be said that the experience thus far had with the equipment of the Silversmiths' building is eminently satisfactory to the owners and tenants, and the former consider that they have been justified by the performance of the plant in taking this radical step in modern practice. Those familiar with the developments in modern construction and equipment will realize the advantages this plan possesses without further enumeration. Mr. Burnham and his engineers believe that they have demonstrated the practicability of the plan they advocated, and the Chicago Edison company is gratified with the expressions of approval from all who are interested in the undertaking. Central station managers will find in this case an excellent indication of the possibilities in this field, and by a closer examination owners of large buildings may learn that economy and convenience are best secured by electrical service where conditions are favorable.

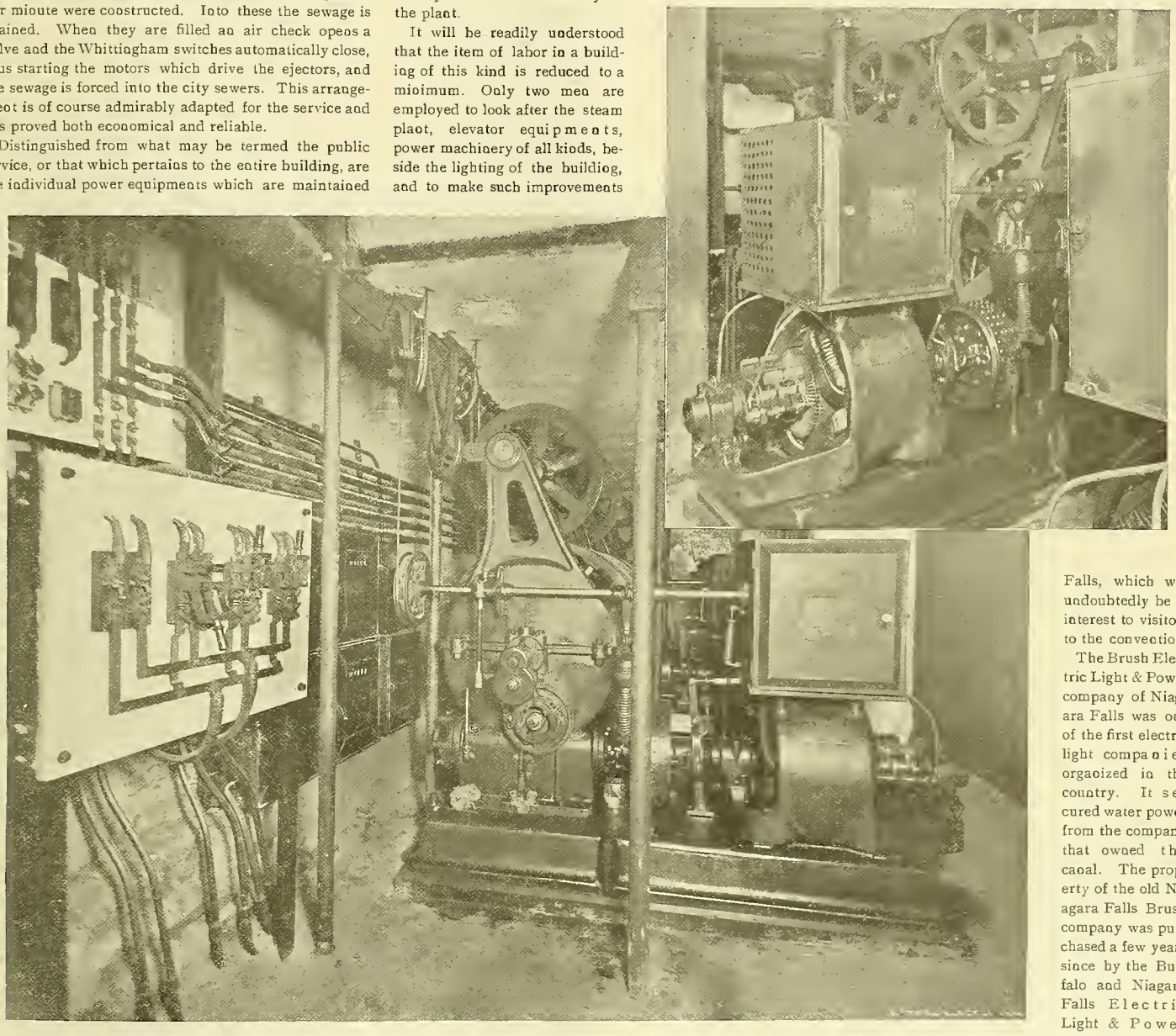


FIG. 4. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—PASSENGER ELEVATOR EQUIPMENT.

Historical Brush Apparatus at Niagara Falls and Vicinity.

The Brush Electric company has a large amount of electric lighting apparatus in the vicinity of Niagara Falls, which will undoubtedly be of interest to visitors to the convention.

The Brush Electric Light & Power company of Niagara Falls was one of the first electric light companies organized in the country. It secured water power from the company that owned the canal. The property of the old Niagara Falls Brush company was purchased a few years since by the Buffalo and Niagara Falls Electric Light & Power company. A new station was erected very near the large power house of the Niagara Falls Power company, from which current was secured to run the motors which operate the dynamos in the local plant. In this new electric light station may be found four 100 light 2,000 candle power Brush arc dynamos, belt driven from motors. The Brush Electric Light company of Rochester, New York, has one of the largest arc lighting stations in the country. These Rochester and Niagara Falls companies were among the first companies in the world to operate electric lighting machinery by water power. The Buffalo General Electric company has a total capacity in its large station of about 3,000 arc lights. This station is located on Elk street. About one-half of these lights are run from 65 light Brush arc dynamos. The balance of them are run from the new large Brush arc dynamos of 125 lights capacity. There are 11 of these large Brush arc dynamos. At Lockport, New York, there is a large amount of Brush apparatus run by water power.

Economy in Electrical Cooking.

By J. E. Woodbridge.

It has often been stated, and with truth, that heating by electricity is sure to be very expeasive as compared with heat from gas or coal, wherever the electrical power has to be generated from the latter or from any source of power comparable in expense with gas or coal, for the following reason: The steam boiler and engine are a very inefficient pair of machines, and as a rule

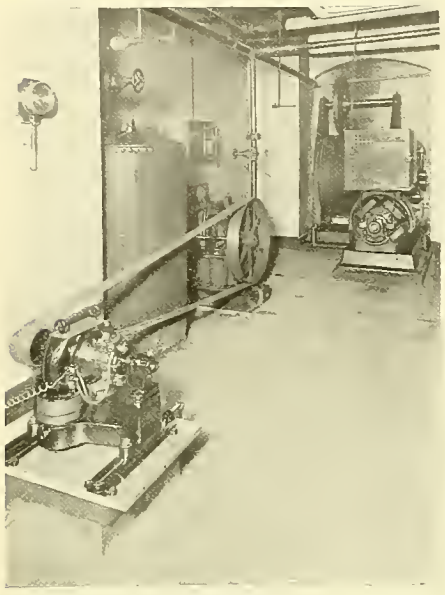


FIG. 5. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—BLAKE TRIPLEX HOUSE PUMP DRIVEN BY CROCKER-WHEELER MOTOR AND FREIGHT ELEVATOR EQUIPMENT.

only change from five to 15 per cent. of the energy of the fuel to mechanical energy. Provided then that there is no further loss whatever in the dynamo and line, there would only be available from the electrical heater from five to 15 per cent. of the heat which the coal used would have given if burned in a stove in the place of the heater.

The calculation of the cost of heat from gas and from electricity shows the difference that might be expected to arise from this cause. Heat from ordinary illuminating gas, giving 500 British thermal units per cubic foot and sold at $1.25 per thousand feet, costs $2.50 per million British thermal units. Heat from electrical power at 12½ cents per kilowatt hour costs $36.75 per million British thermal units.

This difference in cost would prevent entirely the use of electricity for heating if there were not other circumstances to offset it in certain cases. One of these cases

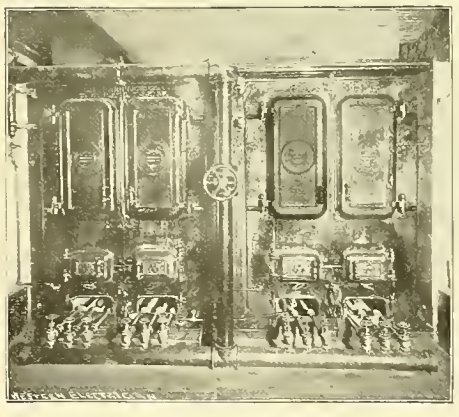


FIG. 7. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—STEAM HEATING PLANT (NATURAL GAS BURNING UNDER BOILERS).

is electrical cooking, and the mitigating circumstance in this case is the enormous waste of heat in the ordinary cooking stove or range. The average kitchen coal stove burns 30 to 50 pounds of coal per day, sufficient to evaporate in a boiler 300 to 500 pounds of water into steam, or to raise 1,800 to 3,000 pounds of water from a temperature of 50 degrees Fahrenheit to the boiling point. With the consumption of all this energy it cooks or heats up, if no water back is used, about 25 to 100 pounds of food and water per day. It is probably a moderate estimate to consider that 95 per cent. of the heat generated goes up the chimney or is radiated directly from the stove to the room. Of the other five per cent. that finds its way to the cooking utensils, a large part is wasted by radiation from their exterior surfaces to the air of the room and by unnecessary boiling.

Where a water back is attached to the stove it absorbs considerable heat, which is largely wasted by radiation from the hot-water tank and partly utilized in the hot water drawn therefrom.

In the case of the gas range the waste is somewhat less, as is shown by the fact that a gas range is cooler to cook by than a coal range and that a gas range wastes no heat up the chimney. However, from the very nature of the process the waste of heat can never be reduced very far, because of the method of the heat transference. In the great majority of utensils the heat is externally generated and transmitted to the surface of the utensil by currents of heated air rising around that surface. The portion of such heat absorbed is bound to be small compared with that carried off by the air. How great this waste is ordinarily, is shown by the surprisingly small fuel consumption of utensils

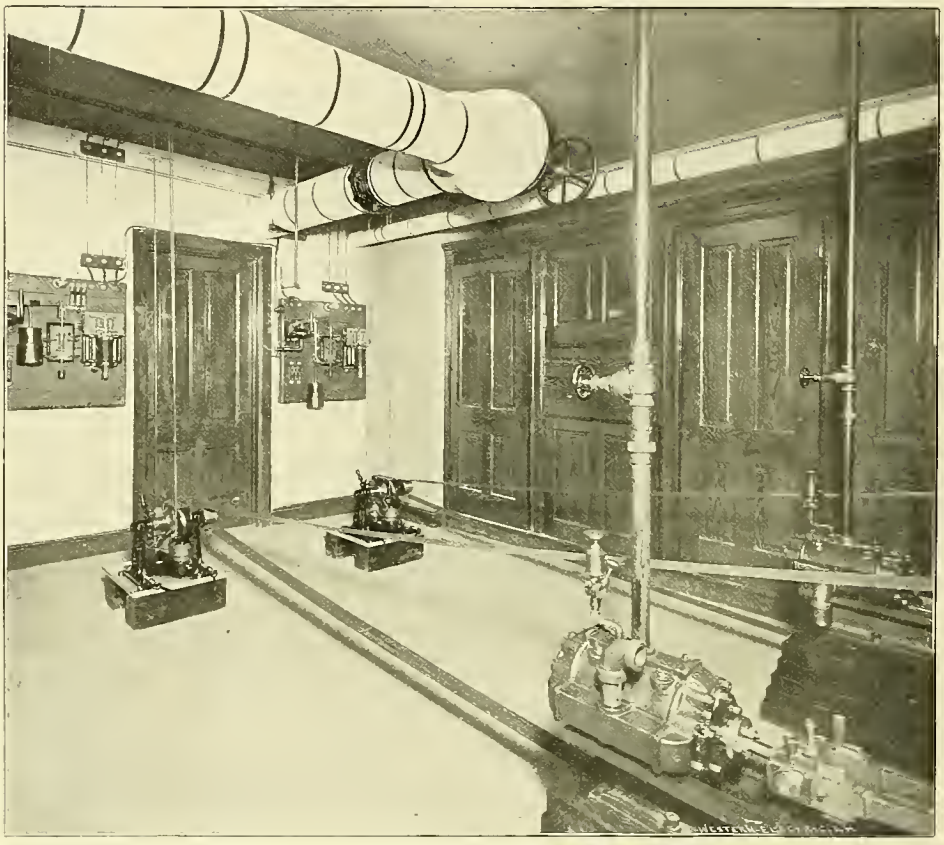


FIG. 6. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—SHONE EJECTORS DRIVEN BY CROCKER-WHEELER MOTORS.

made to minimize it, as, for example, the Atkinson oil ovens.

With electrical cooking, however, the case is quite different. Here there is no combustion, no necessity of heating the external air, or even of applying the heat on the external surface. An electrically heated utensil can, therefore, have its surface lagged or covered with any heat insulator as deep as is desirable, and all the heat can be generated inside this lagging and thereby kept just where it is wanted.

Heat supplied for cooking may be considered to be utilized for two distinct purposes. First, raising the temperature of the water or the materials to be cooked to the proper cooking temperature, and, second, keeping it there. No improvement in devices can of course reduce the amount of heat necessary for the first operation, but the amount used in the second and chief operation can be greatly reduced from present practice. All that is required to maintain a kettle at the boiling temperature is to supply to it the heat which it radiates at that temperature. To be sure, it is customary with the present wasteful methods to evaporate steam at quite a rapid rate from kettles kept at the boiling point, but that is entirely unnecessary. The temperature is no higher for so doing, and the cooking is done no more rapidly than when just sufficient heat is supplied to offset the radiation. This radiation, with utensils as constructed for ordinary stoves, is, of course, very high. No attempt whatever is made to check it. But, as already stated, with self-contained electrical pots, kettles, pans, and ovens, the radiation can be greatly reduced by the use of coverings of non-conducting materials.

This, obviously, can not be so well done if the heat is generated in a stove-like arrangement, on which the receptacles to be heated are placed; so that where economy is an object, which will be most generally the case, each utensil should be made self-contained with its own stove in its bottom. This arrangement would also tend to prevent waste through the carelessness of servants.

If the radiation and thermal capacity of the utensil could be reduced to zero, two quarts of water would require, to raise it from 45 degrees Fahrenheit to the boiling point, one-quarter of one kilowatt hour. Under the best obtainable practical conditions, the energy required would be probably at least 300 watt hours. But once heated the amount of energy needed to keep it so depends entirely on the nature of the utensil.

Some simple experiments were undertaken by the writer to determine the radiation of an average utensil, five inches in diameter and seven inches high,, under various conditions. When uncovered, with the atmospheric temperature 70 degrees, about 150 watts was required to keep the internal temperature at the boiling point. When completely covered with a wrapping of hair felt one inch in thickness, the energy required fell to 25 watts approximately. This simple expedient thus effected a saving of over 80 per cent. While with water heating utensils a large part of the heat used is stored up in the water, to which this saving does not apply; in the case of ovens the saving would apply to the whole heat supplied, since the contents of an oven has a very small thermal capacity, so that virtually all the heat supplied is spent in radiation.

At the rate found in these experiments a cubical oven 18 inches on each edge would radiate at a boiling temperature 150 watts if covered, or 900 watts uncovered.

Wherever hot water is supplied from a central heating plant, as in large flats and apartment houses, this advantage of reduced radiation possible with electrical cooking will be particularly apparent, probably enough so in many cases to offset the lower cost of other sources of heat.

Wherever also economy is any object, electrical power had better not be used for the heating of water. Some separate source of heat should be installed for the supply of boiling hot water. Electrically derived heat may then be used for the rest of the cooking with economy, by having the utensils thoroughly covered, and by mak-

ing the internal resistances sufficiently large to supply a maximum of just enough heat to equal the radiation, allowing none for waste. In that way a two-quart kettle, for example, can be built to run with 250r 30 watts, while if intended to heat its contents with any degree of promptness it would require a whole kilowatt; that rate of power being necessary to heat two quarts of water in 15 minutes.

Since electrical cooking would supply a day load, it is greatly to the interest of central station owners to develop it, and a lower rate for power so used could profitably be given. With a low rate and economical cooking apparatus, in addition to the manifest neatness and convenience of this method, and the growing popularity of everything electrical, cooking by electricity should have quite a rapid growth.

There are evidences that the vital importance of the culinary art is coming to be more and more widely recognized, and that the crude rule of thumb methods of the present are to be replaced by a comprehensive science. When that time comes, the means for exact measurement and delicate adjustment offered by electricity will be greatly valued.

Rules Governing the Width of Leather Belting.

By J. J. Flather.

The problems in belting, although apparently simple, are in reality so complicated, and so many considerations are involved in their solution, that we are not surprised at the multiplicity of varying rules and formulæ by which the power transmitted by a given belt may be obtained.

There are in general five principal considerations which should obtain in determining the size of belt, viz., coefficient of friction, arc of contact, speed of belt, strength of belt per square inch of section and durability.

Experimental work has usually been directed to determine the coefficient of friction, and it has been shown by exhaustive tests that the coefficient of friction, Φ, of leather belting on smooth cast-iron pulleys may vary from 12 per cent. to 165 per cent., depending upon so many factors that it is impossible to so corelate them as to determine accurately what the coefficient may be in any given case.

In general we may say that the value of the coefficient depends upon the nature and condition of the leather, the percentage of slip, temperature and humidity, and probably pressure.[1]

The velocity of sliding, which influences the friction more than any other factor, is directly proportional to the belt speed, and may safely be estimated at one per cent. of the speed per pulley, that is two per cent. for each pair of pulleys. The maximum slip permissible with horizontal belts is about 20 per cent.; a greater slip than this is liable to throw the belt off.

For the past 25 years the coefficient of Towne & Briggs,[2] viz., 42 per cent., has generally been accepted by engineers, but this was deduced from the results of experiments having a large slip (200 feet per minute), which

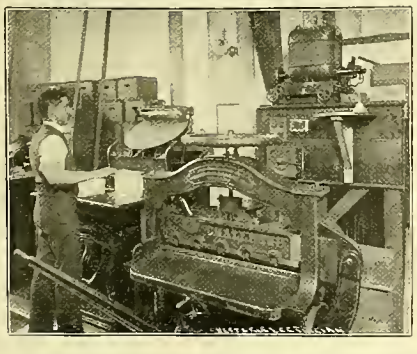


FIG. 8. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—EDDY MOTOR DRIVING PRINTING PRESS.

gave the coefficient equal to 0.58, so that the value recommended is only 0.70 of that obtained by experiment. Even with this allowance it is probable that the value is somewhat higher than average practice would warrant. With percentages of slip varying from 0.8 to two per cent., Mr. Lewis finds the coefficient to vary from 0.25 to 1.38, the first value being obtained for a percentage of slip equal to 1.5, and the second for a slip of 1.7 per cent. Two per cent. slip gave $\Phi = 0.45$. Other experimenters find that Φ varies from 0.12 to 0.58, depending principally upon the rate of slip.[1]

Prof. Lanza's numerous tests made at the Massachusetts Institute of Technology indicate that 27 per cent. is the most suitable value to use for a low rate of slip. His results[2] were obtained on belts running about 1,500 feet per minute and with a slip of about three feet per minute.

Regarding the strength of belting, as might be expected this is extremely variable. Kirkaldy's tests, which cover a wide range, show the strength to vary from 2,000 to 6,000 pounds per square inch of section.[3]

The various tests indicate that double belts are superior to single both in respect to their greater uniformity and also a lesser liability to become crooked by reason of uneven stretching, due, probably, to the fact that the former are composed of two layers, which tend to neutralize any local imperfections occurring in either. It is evident that the strength of a belt cannot be stronger than that of the joint. With cemented joints the splice, if properly made, is not materially weaker than the body of the belt; with riveted joints the ultimate strength, as given by Towne,[4] is 1,750 pounds per square inch and for laced belts 960 pounds.

Prof. Walter Flint of Maine State College finds that metal belt fasteners may cause the joints to fail at from one-fourth to one-half the strength of solid belt, and that laced joints may rupture under a stress of 30 per cent. to 80 per cent. strength of solid belt.[5]

In existing belt transmissions the stress per square inch of section is extremely variable, ranging from 30 to 1,200 pounds per square inch. The reasons for this are two-fold: First, a superior quality of leather will permit a greater stress without undue trouble and expense in repairs; and secondly, some belts are calculated to transmit a stress greatly in excess of that to which they are actually subjected.

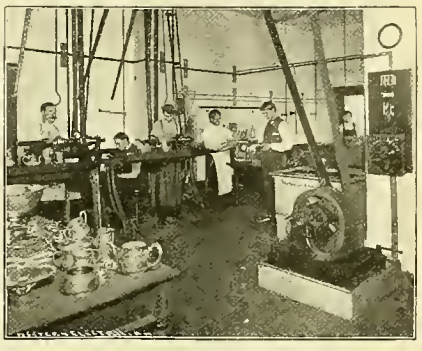


FIG. 9. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—CORNER OF ELECTROPLATING ESTABLISHMENT.

A feature often neglected in the ordinary formulæ is that of durability of the belts. F. W. Taylor, in his "Notes on Belting," states[6] that "the one consideration which should have more weight than all others in making up tables and rules for the use and care of belting is how to secure the least possible interruption to manufacture from this source."

In calculating the total expense of belting and the manufacturing cost chargeable to this account, it has been observed that by far the largest item is the time lost on the machines while the belts are being relaced and repaired; especially is this true in those establishments where the running of a series of machines is dependent one upon another, and the stoppage of one machine involves delays on others.

The results of Mr. Taylor's observations on belting, covering a period of nine years, constitute a valuable compendium on the subject and should be carefully studied. Among many interesting conclusions we note the following:

(a) The belt speed for maximum economy should be from 4,000 to 4,500 feet per minute.

(b) Belts are more durable and work more satisfactorily made narrow and thick rather than wide and thin.

(c) It is advisable to use double belts on pulleys 12 inches in diameter or larger and triple belts on pulleys 20 inches in diameter or larger.

(d) All belts should be cemented instead of laced or fastened in any other way.

(e) When a belt is spliced the tension used should be ascertained by means of a spring balance connected to belt clamps.

(f) The total life of belting, cost of maintenance and repairs, and the interruption to manufacture caused by belts are dependent upon the total load to which the belts are subjected more than upon any other condition. The other conditions are: Method of splicing, care in properly greasing and keeping them clean and free from machine oil, and the speed at which they run. This latter has little effect under 2,500 feet per minute.

FIG. 10. ELECTRICAL EQUIPMENT OF A MODEL COMMERCIAL BUILDING.—EDISON BI-POLAR MOTOR FURNISHING POWER IN OPTICAL WORKS.

(g) The total stretch of leather belting certainly exceeds six per cent. of its original length.

(h) Oak-tanned and fulled belts are superior in all respects (except co-efficient of friction) to either the oak-tanned not fulled, the semi-rawhide, or rawhide with tanned face.

(i) If double leather belts are tightened while at rest 71 pounds per inch of width, and subjected to an additional working load of 65 pounds per inch of width, their tension will fall in 2½ months so as to be, while at rest, 33 pounds per inch width, or 106 pounds per square inch section; their average tension during these 2½ months being 46 pounds per inch width, or 150 pounds per square inch section; their average load during these 2½ months being 111 pounds per inch width, or 358 pounds per square inch of section. These are the conditions under which belts work when tightened according to the ordinary rules.

(j) The most economical average total load for double belting is 65 to 73 pounds per inch of width; *i. e.*, 200 to 225 pounds per square inch of section.

(k) A double belt having an arc of contact of 180 degrees will give an effective pull of 35 pounds per inch width for an oak-tanned fulled belt, and 30 pounds for other leather belts and six to seven-ply rubber belts; or 950 feet per minute of one inch wide oak-tanned and fulled belt will transmit one horse power, and 1,100 feet per minute of other leather belting and six to seven-ply rubber.

(l) Belts should be cleaned and greased every five to six months.

A glance at some of the existing belt formulæ shows that the older millwrights frequently allowed 550 feet per minute for a single belt—only 25 per cent. of that given in section (k), for ordinary belting.

The probable reason for the satisfactory running of these belts has already been pointed out, viz., overrating the capacity of the machine and estimating upon a horse power three or four times greater than actually required.

Some of the more recent rules used by shopmen assume that a single belt one inch wide will transmit one horse power for every 800 to 1,100 feet per minute; Mr. Taylor's rule, it will be noted, calls for a double belt of the same width.

While the conclusions arrived at by Mr. Taylor are extremely valuable from an engineering as well as commercial standpoint, the first cost of equipping a plant under his rules would often prohibit the use of such heavy belts; moreover, in many situations it is probable that equally satisfactory results are obtained under stresses twice as great as those given, especially in those cases where the belt runs at moderate speed over a pair of approximately equal pulleys of large diameter, and is not shifted from one pulley to another. On the other hand, the conditions might be such as to call for certain belts fully as wide if not wider than those given by Mr. Taylor's rules.

Such a case might arise when running at a high belt speed from a large to a very small pulley (or *vice versa*) with the tight side of the belt on top; in this case the centrifugal force would diminish the effective tension,

1. See paper by Wilfred Lewis. Trans. A. S. M. E., vol. vii., p. 549.
2. See Journal of the Franklin Institute, February, 1867.
1. See Trans. A. S. M. E., vol. vii., p. 347.
2. *Ibid.*
3. See Kent's Tables; also *American Machinist*, November 14, 1895.
4. See Journal Franklin Institute, 1867.
5. See *American Machinist*, September 5, 1895.
6. Trans. A. S. M. E., vol. xv., p. 212.

the arc of contact would be lessened, and the adhesion of the thick belt on the small pulley would not be as effective owing to imperfect contact, due both to air entrainment and to a wrinkled belt produced by bending; all of these would necessitate an increased width of belt.

Owing to these various causes it is impracticable to determine a general formula which will be applicable in all cases. We may, however, suggest limitations. As someone has aptly remarked, a significant factor (which, however, cannot enter algebraically into the equation), is the judgment of the designer.

In the following discussion a formula is obtained which, by proper choice of constants (to be selected for any particular case when the data are known), will give a suitable belt width, considering durability and expense of operation, under those conditions which are liable to arise in ordinary practice.

Assuming that the driving force P is equal to the difference in tension T_1 on the driving side of the belt and T_2 on the driven side, and noting that the driving force must equal the friction between the surfaces, we obtain $T_1 - T_2 = P = F$.

The friction F depends upon the arc of contact, a, between the belt and pulley, the coefficient, Φ, and upon the centrifugal force, F_0, set up in the belt, due to its velocity and weight; it is, however, independent of the diameter of pulley. To determine the values of F, T_1 and T_2, it will be necessary to assume a given tension in the belt; also its speed and weight, coefficient of friction and arc of contact.

Let u = friction between element of belt and pulley;
p = normal pressure exerted by element on pulley;
f = allowable working stress in the belt;
= 265 pounds per square inch for laced and 350 pounds per square inch for cemented joints;
v = velocity of belt in feet per second;
w = weight of belt per unit length and area;
= 0.41 pounds per square inch section one foot long;
b = breadth of belt;
t = thickness of belt;
A = area of cross-section of belt;
F_0 = centrifugal force due to speed and weight of unit length;
R = radius of pulley;
T = tension in belt at any point;
T_1 = tension in belt on tight side;
T_2 = tension in belt on slack side;
V = velocity of belt in feet per minute;
a = least arc of contact—circular measure;
= 0.0175 times arc in degrees ($a°$);
Φ = coefficient of friction = 0.27 for small slip and ordinary good belting.

If, in Fig. 1 (page 333), T is the tension in the rope at any point D, then the tension at the point E, whose distance from D is ds, will be $T+dT$. Assuming u to represent the friction on the element DE, we shall have $u = dT$ when the several forces are in equilibrium. Since the friction is dependent upon the normal pressure, p, exerted by the element upon the rim of the pulley, and since this normal pressure is diminished by the centrifugal force due to the weight and velocity of the element, we shall have $dT = (p - F_0)$. For the present we shall neglect F_0. Now p is the resultant of the two forces T and $T+dT$; hence

$$p = T \sin \frac{da}{2} + (T + dT) \sin \frac{da}{2}$$

which may be assumed equal to Tda on account of the smallness of da and dT; therefore

$$dT = \Phi\, T da \text{ or } \frac{dT}{T} = \Phi da \qquad (1)$$

Integrating we have

$$\int_{T_2}^{T_1} \frac{dT}{T} = \Phi \int_0^a da \qquad (2)$$

$$\text{hyplog} \frac{T_1}{T_2} = \Phi a \text{ or } \frac{T_1}{T_2} = \epsilon^{\Phi a}; \text{ therefore} \qquad (3)$$

$$T_1 = T_2 (\epsilon^{\Phi a}) \text{ and } T_1 - T_2 = P = T_2 (\epsilon^{\Phi a} - 1) \qquad (4)$$

If we assume that the working tension per square inch of a leather belt (cemented joint) equals 350 pounds, a convenient value will be obtained for f and one which will give satisfactory results when the belts are properly cared for.

For laced joints three-fourths of this value may be used, *i.e.*, 265 pounds per square inch. Hence, if b = breadth of belt and t = thickness, then $T_1 = btf$. (5)

Now since $T_2 = \frac{T_1}{\epsilon^{\Phi a}}$

we have

$$P = T_1 - T_2 = btf - \frac{btf}{\epsilon^{\Phi a}}; \qquad (6)$$

therefore

$$b\left(1 - \frac{1}{\epsilon^{\Phi a}}\right) = \frac{H P \times 33000}{Vtf}, \text{ or}$$

$$b\left(1 - \frac{1}{\text{anti-log } 0.4343\, \Phi a}\right) = \frac{H P \times 33000}{Vtf} \qquad (7)$$

Substituting the values of Φ and f, assuming $a = \pi$, that is, the arc of contact in degrees = 180°, and noting that

TABLE I.
VALUES OF $C = \frac{Vb}{H P.}$

	Cement joint.	Laced joint.
Single belt	800	1050
Double belt	$\frac{800}{2}$	$\frac{1050}{2}$
Triple belt	$\frac{800}{3}$	$\frac{1050}{3}$

By using the Towne and Briggs coefficient of friction viz., $\Phi = 0.42$, we obtain 650 and 850, respectively, for the values of C in (9) and (10)—a difference of nearly 20 per cent. under the conditions assumed. With a "mellow," supple belt and considerable slip, these values may

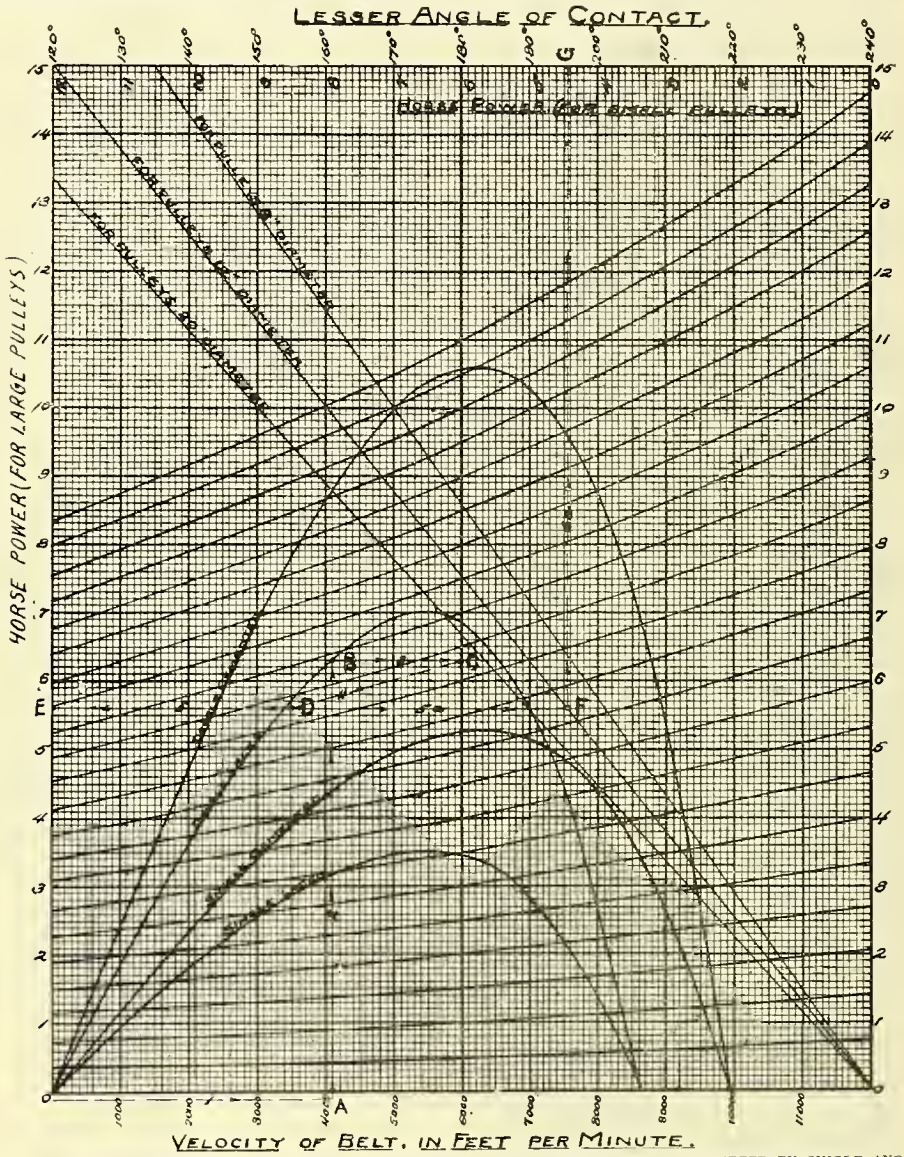


FIG. 2. RULES GOVERNING THE WIDTH OF LEATHER BELTING.—HORSE POWER TRANSMITTED BY SINGLE AND DOUBLE BELTS, ONE INCH IN WIDTH, FOR BOTH CEMENTED AND LACED JOINTS.

the number corresponding to the logarithm $0.4343\, \Phi a$ is 2.3, we have:

$$b = \frac{33000 \times H P}{\left(1 - \frac{1}{2.3}\right) 350 tV} = \frac{166\, H P}{tV} \qquad (8)$$

In average practice t=0.20 for single belting, but varies from 0.16 to 0.25; double belting is supposed to be twice this thickness and varies in the same way. Substituting t=0.20 in (8) we obtain for single belts with cemented joints, after rounding out the values of the numerical coefficient:

$$b = 800 \times \frac{H P}{V} \qquad (9)$$

and for single laced belts

$$b = 1050 \times \frac{H P}{V} \qquad (10)$$

Calling this coefficient C we obtain the general formula:

$$b = C \frac{H P}{V} \qquad (11)$$

in which C has the following values:

give very good results as far as transmitting the power is concerned, but we prefer to use the larger values on account of the greater durability of the belt and consequent freedom from annoyance in stoppage and repairs which, as previously pointed out, should be an important factor in determining its width.

For belts of double and triple thickness, unless large pulleys are used, there is a loss both in bending the belt around the pulley, and in an actual reduction of the effective arc of contact. When the diameter of pulley is less than 100 times the thickness of belt some allowance should be made for this loss. (Reuleaux.)

The amount of increase should be in some ratio, probably inversely proportional to the diameter of the smaller pulley, and to the square of the belt thickness. It is often customary to use 1÷0.7 as a multiplier for all double belts irrespective of pulley diameter, but while this may be satisfactory in every case it is hardly necessary except for pulleys less than eight or nine inches in diameter.

For pulleys about 12 inches diameter 1÷0.8 may be used; and for those approximating 20 inches, 1÷0.9

In the same way for triple belts running over pulleys

about 18 inches diameter the width of belt should be increased in the ratio 1÷0.7; for pulleys about 26 inches diameter 1÷0.8 may be used; and for those about 42 inches diameter, 1÷0.9.

Calling this multiplier, C', we have the values given in the following table:

TABLE II.

VALUES OF C' = MULTIPLIER WHEN DOUBLE OR TRIPLE BELTS ARE USED WITH SMALL PULLEYS.

For double belts when dia. of pulley =	Or triple belts when dia. of pulley =	Value of coefficient, C'
8 inches	18 inches	1÷0.7 = 1.40
12 "	26 "	1÷0.8 = 1.25
20 "	42 "	1÷0.9 = 1.10

Since Table I. was determined with an assumed arc of contact of 180° the values of the constant C should be multiplied by another coefficient when the least arc of contact on either pulley differs materially from 180°. This coefficient, C'', has been derived from equation (3) for different angles of contact from 120° to 240° and is given in the following table:

TABLE III.

VALUES OF C'' FOR DIFFERENT ARCS OF CONTACT.

Value of angle.		Value of coefficient C''.
In degrees.	In circ. measure.	
120°	2.09	1.33
130	2.26	1.27
140	2.45	1.21
150	2.62	1.15
160	2.79	1.10
170	2.96	1.05
180	**3.14**	**1.00**
190	3.32	.95
200	3.49	.91
210	3.66	.87
220	3.84	.83
230	4.02	.79
240	4.18	.75

If the belt can be arranged so that the tight side will be on the bottom of the pulleys the arc of contact will be increased, since the slack side will thus embrace a greater portion of the upper surface of the pulleys, whereas if the slack side be on the bottom the arc of contact will be decreased when the belt is in operation.

At high speeds this is not as noticeable, since the centrifugal force tends to lift the belt away from the surface of the pulley. In all cases, however, it is desirable to so arrange it where practicable.

Thus far we have neglected the effect of the centrifugal force, F_0, set up in the belt, but for speeds over 2,500 feet per minute its influence is appreciable and should be considered. Probably the simplest way to effect this in determining the width of belt is to diminish the allowable tension, f, per square inch of section, subtracting F_0 from f (since T_1 must otherwise be increased by this force); that is, the effective tension per square inch section is $f - F_0$. Since we have used f in

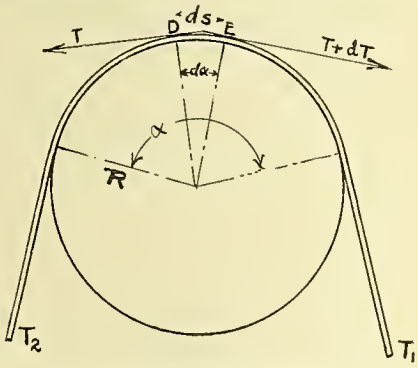


FIG. 1. RULES GOVERNING THE WIDTH OF LEATHER BELTING.

determining the values of C it is evident that these values should be multiplied by a factor k_0 which is greater than f in the ratio:

$$\frac{f}{f - F_0}$$

Since the weight of a unit element of belt is constant, F_0 will be constant for a given speed; but as f=350 in the case of cemented belts and only 265 for laced, we shall have two sets of values of k_0, as shown in the accompanying table which has been calculated from

$$k_0 = \frac{f}{f - F_0} = \frac{f}{f - .41\,\frac{V^2}{g \times 3600}} \qquad (12)$$

TABLE IV.

VALUES OF COEFFICIENT K_0 = MULTIPLIER WHEN CENTRIFUGAL FORCE IS CONSIDERED.

Velocity in feet per minute.	Cemented belt.	Laced belt.
2,500	1.06	1.10
3,000	1.10	1.14
3,500	1.14	1.20
4,000	1.19	1.27
4,500	1.26	1.37
5,000	1.34	1.50
5,500	1.44	1.65
6,000	1.58	1.87

Multiplying these various coefficients together, we obtain the width of belt:

$$b = C\,C'\,C''\,k_0 \times \frac{H\,P}{V} \qquad (13)$$

From this formula and the preceding tables a satisfactory width of belt can be obtained for any given case if the data are known.

For example, let it be required to find width of double belt to transmit 175 horse power at 3,180 feet per minute, pulleys 90 and 60 inches diameter. As cemented joints should be used we shall have:

$$C = \frac{800}{2} \qquad \text{(Table I.)}$$

With the diameters of pulleys used it is probable that $C'' = 1.05$ (Table III.), and $k_0 = 1.11$ (Table IV.), hence

$$b = C\,C''\,k_0\,\frac{H\,P}{V} = \frac{800}{2} \times 1.05 \times 1.11 \times \frac{175}{3,180} = 24''$$

A belt 19½ inches in width was used.

An electric motor running at 1,600 revolutions per minute transmits an average load of 12 horse power through a single belt cement spliced; motor pulley, 7½ inches diameter; driven pulley, 48 inches diameter. Under these conditions the arc of contact (a^0) is about 140°, and V = 2,950; hence

$$b = 800 \times 1.4 \times 1.2 \times 1.10 \times \frac{12}{2,950} = 6''.$$

A single belt (with cemented splice) six inches wide is in use. This belt occasionally transmits 15 horse power for several hours at a time.

The horse power which can be transmitted by a belt of given width may be obtained in the same way by transposition of formula; that is,

$$H\,P = \frac{V\,b}{C\,C'\,C''\,k_0}$$

For example, suppose it be required to determine how much average horse power a 20 inch double belt (cement joint) will transmit when running at a velocity of 3,800 feet per minute, considering durability of belt; the smaller pulley is 16 inches diameter and the arc of contact about 155°. Here C = 800÷2; C' = 1.1; C'' = 1.12 and $k_0 = 1.17$, hence

$$\frac{3800 \times 20}{400 \times 1.1 \times 1.12 \times 1.17} = 135\,H\,P.$$

Fig. 2 (page 332), obtained from the preceding formulæ, shows graphically the horse power transmitted by single and double belts one inch in width for both cemented and laced joints, under varying conditions.[1]

It will be noticed that speed of belt, arc of contact and size of pulley for double belt are all taken into account, and one is enabled to obtain the power transmitted in a very simple manner. The diagram also shows that for laced belts the maximum horse power is obtained at a speed of about 5,400 feet per minute; for cement spliced belts the maximum is obtained at about 6,300 feet per minute, and any increase of speed above these values diminishes the power transmitted, assuming that the allowable belt tension remains the same—as it should.

To use the diagram let it be required to determine the width of double (laced) belt to transmit 30 horse power at 4,100 feet per minute over a 12 inch pulley having an arc of contact of 155°. Beginning at *O* we follow along the base line of velocities to *A* at 4,100 feet, then vertically upward in the direction of the arrow until it strikes the horse power curve for double laced belts at *B*. The horse power transmitted with an arc of contact of 180° and large pulleys would be about 6.3, as shown on diagram, but since the arc of contact is only 155° we project *B* across to the center line, obtaining point *C*; now follow parallel to the arc of contact curve, as shown, until point *D* is obtained on the vertical which passes through 155° at the top of the diagram. For large pulleys, say over 30 inches diameter, the horse power transmitted under these conditions would now be 5.7 horse power as shown at *E*, but we have in this case a small pulley 12 inches in diameter, hence passing from *D* to the left until we strike the diagonal representing 12 inch pulleys we obtain point *F*, and the horse power may now be read on scale at top of diagram corresponding to point *G*, viz., 4.4 horse power. Since 30 horse power is required to be transmitted, the belt will be

$$\frac{30}{4.4}$$

or 7 inches wide.

1. The writer is indebted to Mr. Louis H. Fletemeyer, a post-graduate student in Purdue University, for the very careful manner in which he has calculated and plotted this diagram.

A. G. Davis.

At this time, when the telephone interests of the country are so prominently brought before the people, and especially those concerns which are identified as independent companies, it will be interesting to the electrical trade to know more about A. G. Davis, the president of the Viaduct Manufacturing company of

A. G. DAVIS.

Baltimore, who is often referred to as the pioneer of the electric and telephone business of the South.

In 1871, Mr. Davis, whose portrait is given, organized the firm of Watts & Co., manufacturers of telegraph and electrical supplies, at the corner of Lombard and Sharp streets, Baltimore, with two men. Shortly after this the concern moved to 47 Holiday street, for more convenient quarters, and changed its name to Davis & Watts. It remained there five years, when the partners moved to Monument and Bureau streets, and in 1878 became licensed manufacturers of the Bell Telephone company, and also secured the agency for the introduction of the telephone in the state of Maryland. During this time they perfected the magneto bell, which is now the standard in use all over the United States by the Bell company and by all others. They continued the manufacture and exploiting for that company until 1883, when the license for manufacturing expired.

During the continuance of the firm of Davis & Watts, Mr. Davis organized the Maryland Telephone company, now the Chesapeake & Potomac Telephone company. When the Baltimore exchange had reached 1,500 subscribers Mr. Davis sold his controlling interest therein, and formed the Viaduct Manufacturing company, with works at the Relay, on the Baltimore & Ohio railroad, and has since continued under that name.

Municipal Ownership Idea in Michigan.

[From the *Portage Lake Mining Gazette.*]

We congratulate the people of Hancock in the good sense they have shown in the recent special election regarding the matter of bonding their village for the purpose of erecting and owning a municipal electric light plant. Figures regarding the erection and running of such a plant have been given by believers in both sides of the question, and it has been pretty thoroughly discussed in all its bearings, the preponderance of evidence going to show that in the end it would have been an expensive undertaking, and the citizens of our sister town have acted wisely in rejecting it. From the various reports of electric light companies which have been published it is easy to see that the rates charged by the Peninsula Electric Light & Power company, whose stock is held by people in all parts of the county, are on a fair basis and that we are being furnished with good lights at just rates. When the company started, and indeed for several years, it was nip-and-tuck whether the project would succeed or not, but by good management and fair charges it pulled through and to-day is one of the stable institutions of this section. It employs a good many men and pays out large sums of money all over the county and we believe should be encouraged rather than otherwise, as this section (outside of its mining interests) has too few large employers of labor.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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ONE HUNDRED pages of the size of the WESTERN ELECTRICIAN is a goodly showing for a weekly class publication under the most favorable circumstances, and it is particularly noteworthy at this time, when the industry is just emerging from a period of depression such as has never before been experienced in its history. It may justly be considered a tribute on the part of the electrical interests of the country to the character and the commanding influence of this journal. It is also an evidence of an improvement in the condition of the public mind, showing returning confidence and something of the old-time spirit of enterprise that marked the electrical industry.

As a convention issue this number of the WESTERN ELECTRICIAN is by far the handsomest publication that has ever greeted the electrical fraternity. It possesses many special features that are particularly appropriate at this time, and its mechanical features and artistic illustrations are even in advance of the usual high standard of excellence maintained on all occasions by this journal.

The advertising pages contain the announcements of the very best representatives of the electrical industry of the country, attractively presented, and to the student of commercial progress as well as the buyer of electrical apparatus this department of the paper will prove very attractive. It will not be amiss at this time to call attention to the steady advancement of special convention advertising in the WESTERN ELECTRICIAN as shown by the following table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894	40	56	4,145
February 23, 1895	52	68	5,593
May 9, 1896	72	88	7,576
June 12, 1897	80	100	8,643

These figures do not include the announcements of the WESTERN ELECTRICIAN or the Electrician Publishing company. They show only the actual full paid advertising patronage of this journal, and they speak eloquently of the esteem in which this journal is held throughout the country.

The WESTERN ELECTRICIAN feels considerable pride and satisfaction in this accomplishment, and it is indeed grateful to its many friends through whose earnest co-operation and support it has been enabled to make such a splendid showing at this time and again beat its own record.

WHEN the members of the National Electric Light association assembled at Niagara Falls in 1889 the plans for the utilization of the great water power were not sufficiently advanced to indicate the probable result of the undertaking and the effect upon electrical interests. What was then predicted has now come to pass, and it may be said that the expectations of the best informed engineers upon the possibilities of electrical transmission have been fully realized. Niagara Falls to-day is indeed a wonderful object lesson of what can be accomplished by an intelligent application of the resources of nature to the wants of man.

CENTRAL station managers should learn from experience the necessity of supporting organizations that protect their interests. In the recent attacks upon private enterprises by advocates of the municipal ownership of lighting plants, it is noticeable that in nearly every instance companies have been singled out that are not members of the associations. This may be a mere coincidence, but it is generally understood to be due to the fact that the municipal forces fear the organized opposition of central station men. When the two interests have come into direct conflict the central station has been victorious almost without exception. In fact, at this time not a single instance comes to mind where the municipal ownership idea has been successful when the central station has been identified with the National Electric Light association or the Northwestern Electrical association. On the other hand there are numerous incidents in the warfare between these two elements, with which all are familiar, that demonstrate the power of organization. It is certainly a significant fact that of late all the trouble over this question has been in localities where the central station men have never supported the associations. The lesson which this experience teaches should be taken home by every central station manager in the country.

ENCOURAGED by the success which has attended the movement having for its object the adoption of a standard set of wiring rules that would meet the approval of all the interests involved, many members of the National Electric Light association favor a vigorous crusade against the present method of rating dynamos and motors. That reform in this particular branch of the business is needed goes without saying, and it is believed that every manufacturer of and dealer in high class apparatus will give the movement hearty encouragement and support. It might be well for the association at the Niagara meeting to appoint a committee of experts to consider this subject and receive suggestions from manufacturers and operators of electrical apparatus. Uniformity in rating machines would do away with much confusion and place the selling of apparatus upon legitimate basis. Nowadays the rated capacity of a generator or motor means absolutely nothing. In taking up this investigation the association will confer upon the electrical fraternity a lasting benefit and will be adhering strictly to the original aim of the organization. At the same time it may be said that it will undoubtedly prove one of the most popular movements among the central station managers that has thus far been undertaken.

IF the United States government is to be represented at the Paris exposition prompt action must be taken, not only in determining the nature and extent of the exhibition to be made, but also in organizing the several departments of industrial activity to be included in the display. A joint resolution has been favorably reported to the Senate making an appropriation of $350,000 for this country's representation.

No time should be lost in putting this resolution through Congress. There is no question that this country should be creditably represented at the forthcoming exposition, and no argument should be needed to show the importance of making ample provision and preparation for this important event. In a memorial to Vice-president Hobart the American Chamber of Commerce of Paris urges prompt action and points out that "the exposition will afford unprecedented opportunities to illustrate to the world the immense and diversified resources of the United States and the achievements and facilities of our people in the various departments of human activity." The first steps to be taken are securing an appropriation and the appointment of commissioners. The resolution here alluded to provides for both. Those who remember the labor and disappointments attending the organization of the World's Fair at Chicago need no further reminder of the importance of a seasonable preparation for such an important event.

IT would certainly be a source of annoyance and regret on the part of Americans if the information in private letters of recent date from Honolulu, which say that the Dole government has decided to give to the British company the concession for the ocean cable, should be confirmed. The Hawaiian government has grown weary of the lukewarm attitude of the United States over the cable question, according to the same authority, and has accepted the British proposals. In confirmation of this news is noted the fact that recently the British war vessel Pelican left Sydney to make a survey to Fanning Island, and the Wildswan recently left Honolulu to survey cable routes around that island, which will be the main landing place for the cable.

Another story comes from Honolulu to the effect that Japanese capitalists are seeking a franchise for a cable between this country and the Orient, and that their agent is now at the Hawaiian capital endeavoring to secure permission to land the cable there, and also soliciting aid for the project from the government. The plan, as outlined, is for the construction of a cable from Hawaii to Japan, and later, an extension of the line to this country. It is proposed to issue capital stock of $10,000,000 and to dispose of five-tenths in the United States, four-tenths in Japan and one-tenth in Hawaii. Assurance is given that the Japanese government will give a subsidy of $500,000, and belief is expressed that the United States government would give an equal amount. The Japanese stand ready to subscribe $5,000,000. The Great Nippon Steamship company, which has a capital stock of $11,000,000, would become a large shareholder. It may be objected that this country may not take kindly to a project started and conducted by Japanese capitalists, and that there may be opposition to the government granting a subsidy to such a company. It would seem as if American capital would be much more favorably disposed toward an enterprise started in this country than one under foreign management.

The Omaha Exposition and Its Electrical Features.

Inasmuch as the National Electric Light association will be officially invited, through Professor Owens, to hold its next convention in Omaha during the Trans-Mississippi and International Exposition, which will be open from June to November, 1898, it is of interest to consider the general scope and plan of the exposition, and particularly what is proposed in the way of electrical exhibits and electrical attractions.

Preliminary steps to carry out the enterprise were taken by the citizens of Omaha early in December, 1895, when a temporary organization was effected. On January 18, 1896, articles of incorporation of the Trans-Mississippi and International Exposition association, signed by 100 leading business and professional men, were filed with the secretary of state. The authorized capital of the corporation is $1,000,000. On December 1, 1896, the stockholders elected a board of 50 directors, and a permanent organization was at once effected by the election of the present officers. The directory chose from its members a board of seven managers, which, as now constituted, is the governing power of the exposition.

A short time prior to the completion of the permanent organization a bill was introduced in the United States Senate granting the exposition recognition by Congress as an interstate and international exposition, providing for the admission of foreign exhibits free of duty, and pledging the United States to expend not less than $250,000 for a government building and exhibit. A similar bill was introduced in the House. These bills were finally consolidated in conference at the close of the session, and the bill authorizing $200,000 to be expended for a federal building and government exhibit was signed by the president before the adjournment of the session in June, 1896. In December an item was inserted in the sundry civil appropriation bill providing for the appropriation authorized in June. This bill passed both houses of Congress, but failed to receive the president's approval. At the extra session of Congress, March 15, 1897, this bill was re-introduced and has already passed the House. The bill is in the hands of the conference committee. Its final passage, it is confidently asserted, is but a matter of a few days.

A condition precedent to the congressional appropriation was that not less than $250,000 in *bona fide* subscriptions and donations must have been secured by the Trans-Mississippi and International Exposition association before the federal appropriation became available. This requirement was long ago complied with. Up to the first day of January the stock subscriptions and donations aggregated over $400,000, and the total sum now exceeds $600,000. This includes the subscriptions of the Burlington and Northwestern railroad companies—$30,000 each—that of the Rock Island, $20,000, that of the Milwaukee & St. Paul, $10,000, and that of the Omaha Street Railway company, $10,000. Other great railway systems whose lines traverse this territory have promised to donate liberal sums. It is estimated that their total subscriptions will approximate $150,000. Z. T. Lindsey, manager of the Department of Ways and Means, is confident that he can raise the total of stock subscriptions to $1,000,000. A. L. Reed, manager of the department of concessions, reported at a recent meeting of the executive committee that he had received 46 *bona fide* applications for space covering 197,000 square feet. The guaranteed income from these concessions will be large.

The Nebraska Legislature appropriated $100,000 in aid of the exposition, available the first week of July, 1897. The Legislature also passed a law authorizing the county to issue bonds in the sum of $100,000 for exposition purposes. The Park Commission will use the proceeds of this year's levy—nearly $50,000—in beautifying portions of the exposition grounds and the main boulevards leading thereto.

Neighboring states are manifesting great interest in the exposition. Iowa has made a preliminary appropriation, as has Montana, Utah and New Mexico. South Dakota is preparing to make a great exhibit of minerals, while Colorado will rival it. Louisiana, Kansas, Missouri, California and Wyoming will be well represented in the exhibits, as will many other states and territories of the West. The Illinois Legislature will, it is asserted, appropriate not less than $50,000 for a state exhibit. Edward Rosewater, manager of the Department of Publicity, has been assured that his efforts before the Illinois Legislature will secure the appropriation.

The exposition grounds are known locally as the old fair grounds, situated in the northern suburbs. Many acres adjoining will be enclosed for the purpose of the exposition, affording ample area. Three electric railway lines now run to the grounds, over perfectly level streets, from the heart of the city, admitting of heavy trains and rapid transit. Steam cars may run every minute from the Webster street station or from the Union Depot at Tenth and Mason streets, and from either point the run can be made in 10 minutes. Trolley cars make the run from the new government building, at Sixteenth and Dodge streets, in about 10 minutes. The exposition grounds are most accessible, and ample transportation facilities will be provided.

Preliminary plans, as submitted by the architects, are thought to warrant the prediction that the architecture of the Trans-Mississippi Exposition will be second only to that of the World's Fair. The colonnades will be in brilliant colors. It is to be a Pompeiian rather than a white city. Most of the buildings will be constructed this year. Eminent architects have been selected to design the great buildings, as follows: Agricultural, Cass Gilbert, St. Paul; art, Eames & Young, St. Louis; electricity and machinery, Dwight Perkins, Chicago; mines and mining, J. J. Humphrey, Denver, Col.; manufactures and liberal arts, S. S. Beman, Chicago; spectatorium, Fisher & Laurie, Omaha. Walker & Kimball, the supervising architects, designed the general plan of ground and buildings, and they will make designs for all structures other than the main buildings as above. Their sketches of the arch of states and the administration arch are highly pleasing.

PROF. R. B. OWENS, COMMISSIONER OF ELECTRICAL SECTION, OMAHA EXPOSITION.

The first conference of the architects of the main buildings was a pleasing surprise to those concerned. It had been anticipated that when the preliminary sketches of the buildings on the main court were presented many changes would be required in order to produce a harmonious result, as none of the architects had any opportunity to learn what the others would produce, but when the sketches were shown it was found that scarcely any changes would be necessary. The general designs of all the buildings were found to be entirely harmonious, and congratulations were freely exchanged. The sketches in question were not supposed to be complete in the details of ornamentation, etc., but were simply intended to be suggestive. By a curious coincidence, all the buildings were designed along the Renaissance style. This style will allow of the greatest latitude in the way of ornamentation, and the treatment of columns, capitals, etc., will be broad and pleasing. The architecture will be strictly classic, but along lines which will comprehend the best effects. Some of the buildings will have flat domes, but the majority will have pinnacles. The treatment of the domes and pinnacles, as well as of the general details of ornamentation, is a matter of future consideration at the hands of each architect. As soon as the finished drawings of the buildings are received by the supervising architects they will be given the widest publicity.

Mr. Perkins, the Chicago architect, has not completed his preliminary sketch of the electricity building. It will suggest an arcade front, with heroic groups indicating the character of the exhibits. At this writing it is impossible to give a description of the proposed building, the estimated cost of which is $100,000.

The work of construction is now going on. Contracts for the administration arch will be let in a few days. Excavation for the lakes and lagoons proceeds rapidly. Five miles of fence enclose the grounds, whose area is about 200 acres.

Electricity, applied in different ways, scientific, industrial and decorative, will form the most attractive feature of the Trans-Mississippi Exposition. Already active rivalry exists between prospective exhibitors in the electrical section, for Manager E. E. Bruce of the Department of Exhibits has announced special prizes—gold trophy, silver cup and gold medal—for the best electric light service and display. The manner in which applications for space are coming in is a source of satisfaction to the manager of the department and his active lieutenants. More space has been allotted to exhibitors than was taken at the Atlanta exposition up to three months prior to the opening of the gates. Every mail brings a batch of applications from the East, and it is wholly within bounds to predict that the great manufactures building, and particularly the electrical section, will be fully representative.

Prof. R. B. Owens of the Nebraska State University, whose portrait accompanies this article, has been appointed commissioner of the electrical section of the exposition. Professor Owens' appointment as commissioner for the electrical section is regarded with much favor. He is well qualified for the duties of his responsible position, and he will have full charge of the work of organizing and superintending the electrical department. Beside the convention of the National Electric Light association, the professor will endeavor to secure other meetings of technical societies for 1898, as of the American Institute of Electrical Engineers, American Society of Mechanical Engineers and the American Street Railway association. It is the intention to make the exposition an irresistible magnet of attraction for every person interested in the scientific and practical study of things electrical.

It is hardly necessary to say to the readers of the WESTERN ELECTRICIAN that Professor Owens is in charge of the Department of Electrical and Steam Engineering at the university in Lincoln. As an educator he is distinguished by his desire to give a training to his students that is thoroughly practical and useful. He is a young man of the present generation, alert, progressive, enterprising. His practical experience in electrical affairs is of much assistance to him and will count in his new position with the Omaha exposition. Professor Owens is a native of Maryland and obtained his education in that state, studying with Dr. Louis Duncan and other instructors at the Johns Hopkins University in Baltimore, where he stood well in mathematics and physics. In 1891 he obtained the post-graduate degree of E. E., from Columbia, under Professor Crocker, and was a member of the first class in the United States to receive this degree. In the intervals of his school preparation the young student acquired a fund of practical knowledge, first with the old Baxter Motor company, then with the Excelsior company and also as superintendent of a Thomson-Houston station at Greenwich, Conn. Shortly after receiving his degree Mr. Owens was appointed adjunct professor of electrical engineering in the University of Nebraska, and in 1894 he was made full professor, having in the meantime served as one of the judges of electrical exhibits at the World's Fair. Full charge of the Department of Electrical and Steam Engineering was conferred on Professor Owens in 1895. Professor Owens believes that the technical school should be in close touch with the best practice, and usually spends his summers in work that increases his experience in solving actual, every-day problems. His new duties will not make it necessary for him to sever his connection with the university; and it is safe to say that the electrical department of the Trans-Mississippi Exposition will greatly benefit by his reputation, knowledge and experience.

At the annual meeting of the Niagara Falls Power company, held June 1st, the officers and directors were re-elected. The capital stock of the company was increased from $3,000,000 to $3,500,000. The contract for the building of the addition to the power house, and for the structural steel work for the wheel-pit, will be awarded by the directors of the power company at a meeting to be held in New York shortly.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part VIII.

Generators and Switchboard.

Generators.—Dynamo-electric machinery installed in a power house for the purpose of furnishing current for incandescent lights, arc lamps or for motors, may consist of such a variety of types, and each type may embrace such a multiplication of details, that it will hardly be expected that, even if a classification were attempted, one lecture would do justice to the subject. An exhaustive discussion upon the design of dynamos will not be attempted, but it will be our purpose to consider some of the practical points a designer of plants should know in order to make an intelligent choice of a generator.

Considerable discussion has been carried on in regard to the best metal for the field magnet frames, wrought-iron, cast-iron and cast-steel all having their respective advocates. Wrought-iron possesses the highest permeability, having a saturation of about 90,000 lines of force per square inch, and therefore allows the use of a much smaller frame for a given output, but it is impracticable for complicated shapes or large sizes on account of the expense of forging it into proper shape. Cast-iron is cheap, easy to cast and machine, but as the saturation of cast-iron may be taken at about 35,000 to 40,000 lines per square inch, a frame of this material must be comparatively large and heavy. Cast-steel allows a maximum flux density of between 70,000 and 80,000 lines per square inch, or about 80 to 85 per cent. of the saturation of wrought-iron; it can be cast in any desired form and combines all the other desirable points of cheapness and strength. Very often, however, the power station designer will not object to the extra weight of the cast-iron frame, as it will, if judiciously distributed, add much to the stability of the machine. A combination frame composed of wrought and cast-iron has gradually found a place, especially in the field of large power generators. In this construction the magnet poles are built up of laminations of wrought-iron, or sheet steel riveted solidly together and cast into the magnet yoke, the joint between the two metals being practically perfect on account of the laminated ends of the poles becoming fused when the molten cast-iron is poured around them, resulting in a practical weld. This secures high permeability for the poles, on which account they may be made smaller than if made of cast-iron and therefore require much less copper for the winding of the magnet coils. Cast-steel may be substituted for the wrought-iron poles with the same result.

As for the general shape of the magnet frame, no particular type can be said to be greatly superior to any other. The object, of course, is to secure the shortest possible magnetic circuit, but it is well to avoid that class of machines in which the maker has been guided by the evident purpose of securing a dynamo which will look in no way like those manufactured by his competitors. For a large class of machines the multipolar type with inwardly projecting pole-pieces disposed at equidistant points about the armature has become standard, although one well-known generator is made with internal field pieces, surrounded by the revolving armature. As a rule, joints should be avoided wherever possible, but the additional reluctance introduced into the magnetic circuit by a break in the metal is not as important, if the joint be perfect, as it is generally supposed to be.

Some provision should be made to allow the easy removal of the armature, and this may be accomplished in one of a number of ways. The frame may part on the horizontal center line, so as to allow the removal of its upper half by a traveling crane or otherwise; it may be parted on the vertical center line, which will make it possible to separate the two halves of the frame by sliding them on the cast-iron sub-base, or the entire magnet frame may be moved along the shaft a sufficient distance to clear the armature. On small machines the armature may be taken out by removing one of the boxes or shaft bearings, preferably the one on the opposite side from the commutator, while with the type of machine with external armature, already alluded to, provision is made for moving the armature away from the internal pole-pieces.

With belted machines the center of gravity should be as low as possible, and generators of this class are preferably constructed with a spreading cast-iron base, which will bring the heaviest part of the frame below the armature. Belted machines are provided with some device for moving the machine and tightening the belt. This movement should always be accomplished by one lever or wheel, as serious injury has resulted in cases where the attendant tightened one side of the dynamo more than the other. The sub-base upon which a belted machine rests should be solidly constructed and as heavily built as the floor line of the dynamo will allow. To avoid vibration the contact between the dynamo frame and the surfaces on which it slides should be directly under the bearings, and additional surfaces should be provided if the generator is a large one.

The windings on the magnet coils, while preferably round, on account of economy of copper in winding, may be of any shape, but they should be easily removable, and the coils upon different pole-pieces should be perfectly interchangeable.

The armature should be built up of wrought-iron disks, and the periphery should be slotted to admit the armature winding. "Smooth core" armatures were formerly prevalent, but at the present the "toothed" armature is almost universally adopted, and the armature conductors are secured in the armature slots in such a way as to make the use of binding wires unnecessary. In fact, on large machines the conductors no longer consist of wires wound about the armature, but are made of strips or bars of copper, which are formed by a machine to a particular shape and laid in place in the armature slots. This secures a simple, symmetrical, well balanced armature, which is very durable, and, if anything should happen to it, it may be easily repaired by simply removing the injured coils and replacing them. All soldered joints in the armature conductors themselves should be avoided, although one joint will be necessary where the windings are attached to the commutator. This joint, however, should be placed where it is convenient in case repairs are necessary, and the contact area between the wire and commutator should be at least eight times the cross-section of the wire in order to avoid the melting of the solder.

The size of the armature conductors and the amount of ventilating surface should be so proportioned that the armature will not heat more than 40 degrees Centigrade above the temperature of the surrounding atmosphere when running for long periods at full load. For arc light dynamos with a constant current of 9.6 amperes the winding should consist of wire not less than No. 15 B. & S. gauge.

The commutator should be built up of pure hard drawn or drop-forged copper segments. If air insulation is used the segments should be mounted upon porcelain or similar non-absorbent material, and should be readily accessible for cleaning. For incandescent and power generators the insulating material between the segments should be mica. The greater the number of segments the less the tendency to spark, while at the same time the less the voltage between adjacent segments. In a direct current generator there should never be over 20 volts between two adjacent commutator segments, and this should preferably be about 15. To find the number of segments a commutator should have, multiply the number of pole-pieces by the voltage of the dynamo and divide by the allowable voltage between segments. For instance, a 600 volt generator with eight poles should have not less than

$$\frac{8 \times 600}{20} \text{ or}$$

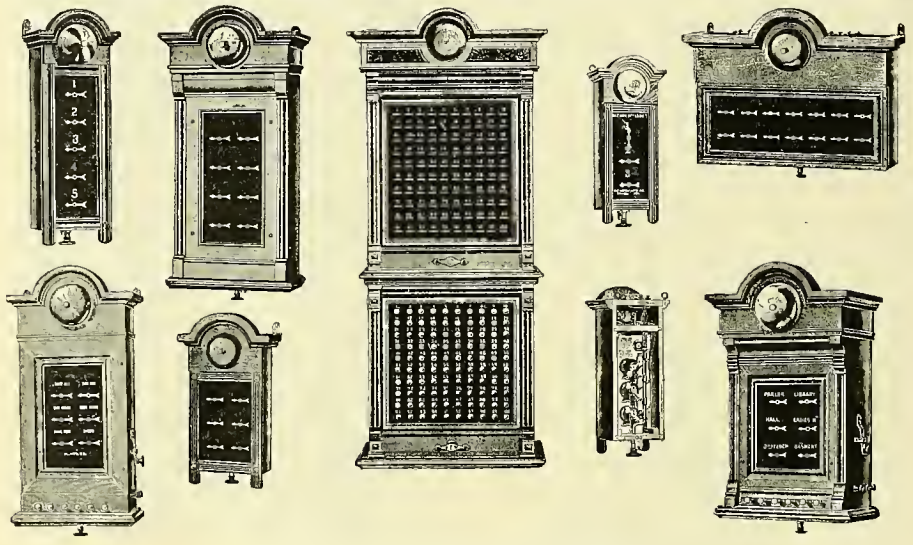
240 commutator segments. Large commutators should be made in sections so that one part can be repaired without rebuilding it entirely. The area of the commutator exposed to brush contact will depend upon the kind of brushes used. If a carbon brush is adopted, the brush surface ought to be calculated for not over 35 amperes per square inch for 110 volts and not over 25 amperes per square inch for 500 volts. Copper brushes will permit a much higher figure, and it will be safe to allow 100 amperes per square inch. In other words, if carbon brushes are used, the commutator must present four times the brush surface required with copper brushes. Carbon brushes will be found preferable, however, though little can be said against some of the modern forms of woven wire or composition brushes now on the market.

Brushes should be provided with an easy means of adjusting the tension on the commutator while the machine is running at full speed. The device should be carefully designed, especially with arc and alternating current machines, so as to avoid danger to the operator. Insulating handles should be provided to all set screws, tension adjustments and other parts which may require handling in setting or adjusting the brushes. Ample current-carrying capacity, which should be figured at about 40 amperes per square inch, must be provided, both in the contact between the brush and holder and in the brush-holder itself. It is usual to have as many sets of brushes as the machine has poles, and some device must be provided to shift all the brushes, with changing-load, at the same time, by the movement of a hand-wheel or otherwise. In large machines some arrangement should be made to lift and to replace all the brushes on the commutator together. With railway generators a single point of commutation is absolutely necessary, as the rapid changes in load from nothing to 50 per cent. overload make the shifting of the brushes impracticable.

Generators are universally provided with the well-known self-oiling, self-aligning type of bearings which adjust themselves to the exact direction of the shaft. For belted machines the length of the bearing should be five or six times the diameter of the shaft, and in any case if over five inches in length it should have at least two oil rings or chains. These rings should be easy of inspection through a hole in the upper half of the box, and should revolve with the shaft, delivering to it a copious supply of oil from the reservoir in the box below. It is necessary to have some method of drawing off the oil, and the upper half of the box should be removable to allow inspection of the journals and to allow the removal of the armature for repairs.

In calculating the diameter of the shaft liberal allowance must be made for the magnetic pull due to the eccentricity of the armature, as heretofore mentioned. Little fault can be found with a shaft that is too large, while an endless amount of trouble has ensued from shafts which were but a fraction of an inch too small for work they had to perform. The shaft and bearings should be so proportioned that the weight upon the bearings shall not exceed 150 pounds per square inch, taking into consideration the extra strain imposed upon them by the magnetic pull of the armature.

The most important point of all the requirements of a good machine is the insulation. The insulating material used in the construction of a generator should not only have a high insulating quality but it should be mechanically strong and should retain permanently its insulating quality. It should be especially noticed that all insulating parts exposed to the atmosphere be of a non-absorbent material. The higher the voltage at which the machine is intended to operate the greater must be its insulating resistance. For machines operating at 110 volts it is usual to specify an insulation of at least one megohm (1,000,000 ohms) between any or all the conducting parts and the magnet and armature cores or the frame of the machine. For railway generators of 550 volts the insulation should measure at least three megohms with the machine connected ready for operation, while with arc light dynamos and alternators the insulation between armature coils and shaft should measure out five megohms. The test should be made in each case with a testing battery of about 100 volts, and should be conducted with the machine both hot and cold. Beside this mere insulation resistance test the generator should be capable of withstanding a "break-down" test, in which it should stand without injury an alternating pressure of fully four times the voltage at which it is intended to operate the machine.



MOON MANUFACTURING COMPANY'S ANNUNCIATORS.

In operation the machine should run without any sign of sparking at the commutator. This provision applies now to incandescent and power generators, and it will be but a short time before it will not be unreasonable to expect sparkless operation from even arc machines. The dynamo should run noiselessly. The "musical hum" which is caused by the armature windings entering or leaving the polar fringe too abruptly can be avoided by properly shaping the ends of the pole-pieces.

A heating limit of 40° C. above the surrounding atmosphere has been mentioned for the armature coils. This limit should apply to all other parts on the surface of the machine. In fact, it is this heating limit that furnishes a basis for the rating of the generator capacity. The rating of an engine is determined by the cylinder dimensions, the steam pressure, the most economical point of cut-off and the revolutions per minute, but with a dynamo no such mathematical determination of capacity is possible. With a generator of constant speed and voltage intended for parallel distribution the possible output depends upon the rise in temperature allowed after a continuous period of operation at full load. With this specified as mentioned, in any case the purchaser may expect to secure a dynamo with sufficient electrical capacity for the desired output. With constant current series machines the output of course is a question of voltage and not so much of current-carrying capacity, the heating effect due to the C^2R losses being the same whether one or 100 lamps are being supplied with current.

Arc machines with a capacity of 125 lamps are becoming standard, and machines of larger dimensions and capacities, capable of supplying four or five circuits of

125 lights each and running at a speed of 100 to 300 revolutions per minute, would meet with ready favor at the present time. It is to be hoped that builders of arc lighting generators will soon develop such a machine, for arc lighting generators would then be placed on the same basis as power and incandescent machines now are, and the new type would permit the adoption of direct connection throughout in lighting stations.[1]

Four-pole power generators seem to have reached the limit in the belted type at an output of 300 kilowatts at 400 revolutions per minute, or a capacity of 75 kilowatts per pole. Machines larger than this are generally of the direct-connected type. Successful operation of 500 volt railway generators seems to be the best when the output does not exceed 100 kilowatts per pole. Generators of large output, then, will have a correspondingly large number of poles. This means an armature of large diameter, and consequently a smaller number of revolutions per minute, in order to keep the peripheral speed within limits, which should not exceed 4,500 feet per minute. The selection of slow speeds for large direct-connected generators is thus seen to be a natural requirement of the generator itself. Generators of 1,500 kilowatts are now not uncommon, running at speeds of 80 to 100 revolutions per minute.

In regard to efficiencies it will not be unreasonable to specify the following:

Type.	Full Load	75 % Load.	50 % Load.	25 % Load.
Direct-driven direct current...	94	93¾	93	90
Belt-driven direct current.....	93½	93	91	84½

For very large machines the efficiencies may be slightly better and for small dynamos hardly as good. These figures refer, of course, to the "commercial" efficiency of the machine, and take into account not only to the C^2R losses, due to the resistance of the armature and field windings, but also the iron losses due to hysteresis and eddy currents and the mechanical losses due to friction. The term "electrical efficiency" is a laboratory phrase and is not used in specifications for generators. It will be noticed that the efficiency of a belted machine is lower than for a direct-connected generator. This comes from the fact that with a direct-connected unit all the losses due to mechanical friction at no load are charged up against the driving engine.

[The concluding portion of Part VIII., relating to the switchboard, will appear next week.]

Moon Manufacturing Company's Annunciators.

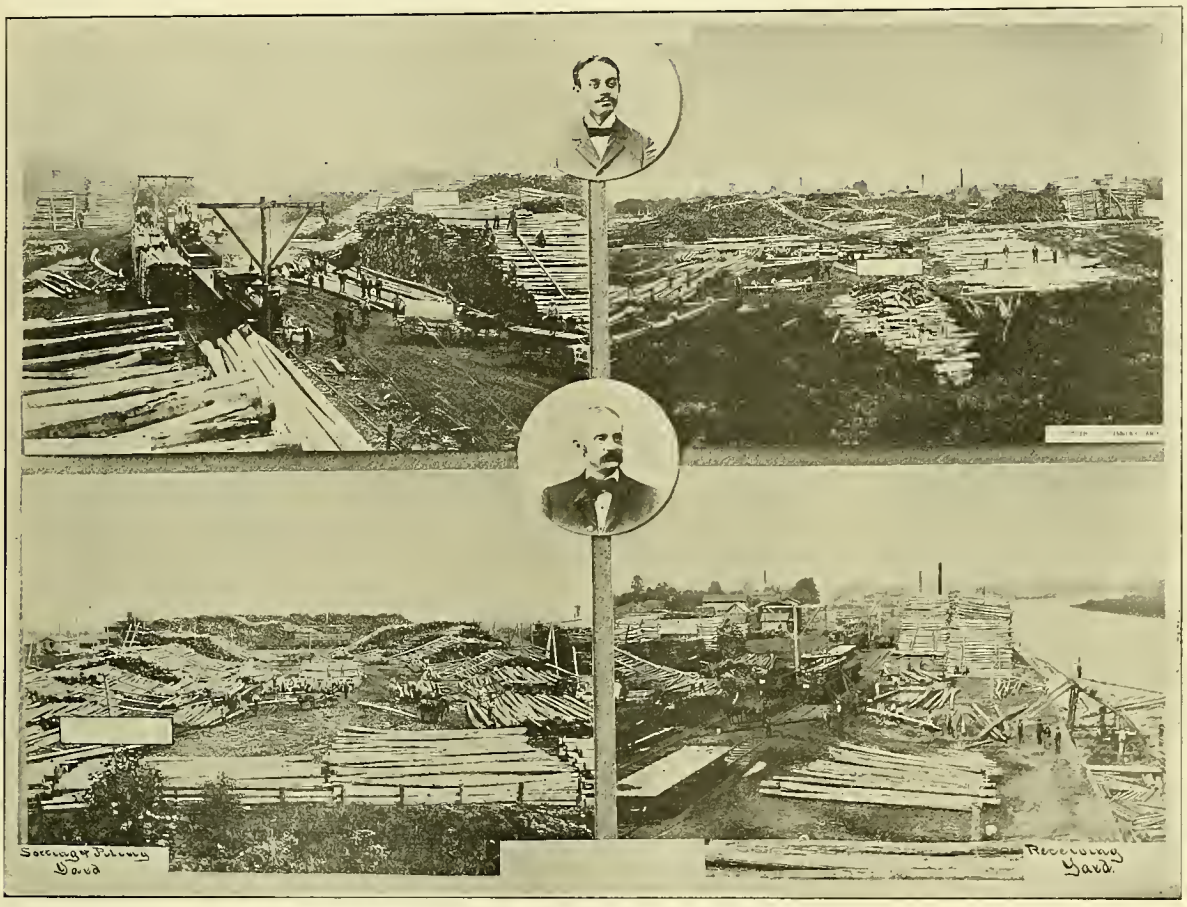
The cut on page 336 illustrates annunciators manufactured by the Moon Manufacturing company, Canal street, Chicago, and known as the "Knapp annunciator." The rights, patents, etc., for its manufacture and the tools and patterns were purchased from the old Knapp Electric Manufacturing company. Included in the illustration is also the improved Knapp burglar alarm.

The Knapp annunciator will be found in some of the largest hotels in Chicago and other cities, among them being the Great Northern Hotel, 1,100 drop; Chicago Beach Hotel, and the Leland Hotel, Chicago. The following types are furnished. House annunciator: Two styles of cases, any finish of wood desired, and in sizes from two indications to 24 indications. Hotel annunciator: In sizes from 20 numbers upward; also furnished with guest call, and with guest call and fire alarm. Elevator annunciator: In sizes from four numbers to 12 numbers. Burglar alarm annunciator: In sizes from four numbers to 20 numbers. Continuous ringing attachment and silent test.

The improved Knapp burglar alarm is claimed to be one of the handsomest and most complete instruments ever put on the market. It has separate cut-outs for each indication, also silent and battery tests, spring switches on the side which cannot be left out of place by an unskilled operator. The alarm bell, the constant ringing drop, also the test switch, have platinum contacts which insure absolute working of the instrument at the proper time.

The Moon Manufacturing company announces that it carries in stock about 5,000 annunciator cases in the various sizes, styles and kinds of wood; also a large stock of the smaller sizes made up complete, ready for immediate shipment, which enables the company to give patrons the benefit of prompt delivery as well as an article of the finest make.

1. Since this lecture was delivered it has been ascertained that two of the leading manufacturing companies are engaged in developing a machine of this type.



HOW CEDAR POLES ARE HANDLED BY W. C. STERLING & SON.

How Cedar Poles Are Handled by W. C. Sterling & Son.

One of the oldest and largest cedar pole firms in the United States is that of W. C. Sterling & Son, located at Monroe, Mich. W. C. Sterling entered the cedar business in 1880, and has so increased the business that the firm now has eight large cedar pole yards in Michigan.

When the poles are rafted down the lakes in lots of 20,000 they are taken from the water by means of a steam elevator, as is shown in the picture of the receiving yard. Each pole is here inspected the second time, carefully peeled and trimmed of knots, and all crooks are cut out, leaving the pole ready to be shipped to any city for the best of pole lines. After the pole is properly inspected and manipulated for a first-class pole, it is hauled to the pile to which it belongs. Each length and size of top has a separate pile, so that an order received may be loaded at once, no sorting or delay being necessary. For this reason this firm has established a reputation for speed in delivery and uniform quality.

W. C. Sterling & Son handled over 150,000 poles last year, and have a force of eight foremen, 10 office men, 150 woodsmen and 50 yard men. During the last year this firm shipped a consignment of cedar poles to Benuos Ayres, South America, as well as several large shipments to Texas, Salt Lake City and Colorado. Many of their poles are sold in Canada.

The details of the business are so well arranged and managed that the poles are now sold cheaper than at any time in the past.

Considerable skill is necessary to manufacture such poles as will answer requirements for city use. A pole must be reasonably straight, peeled and trimmed and well proportioned. This requires considerable work, as the cedar right from the swamp is in a rough condition and more or less crooked. Poles range from 25 to 75 feet in length. The 25 and 30 foot lengths range in diameter at the top from 5.6 to 7 inches. Above these lengths the tops are 6 and 7 inches.

At Monroe, Mich., the headquarters of this firm, is situated what is believed to be the largest pole yard in the world. However, the increase in competition required the opening of the firm's northern yards to save the expense of one handling. The poles are here taken directly from the cedar swamps to the yards by wagon or driven down the river. Some poles are floated over a hundred miles, and at one time last season Sterling & Son had a solid jam of cedar poles five miles long which finally reached the yards by using dams to furnish the depth of water to float this mass down.

Cedar poles, under ordinary circumstances, last many years, the lasting qualities depending upon the soil in which they are placed. The number of trees cut yearly to furnish poles for the repairs and extensions of the large electrical companies to which this firm sells and to the new companies which are now being organized for street railways, telephones and lighting is enormous, and plays havoc with the best cedar swamps in the North.

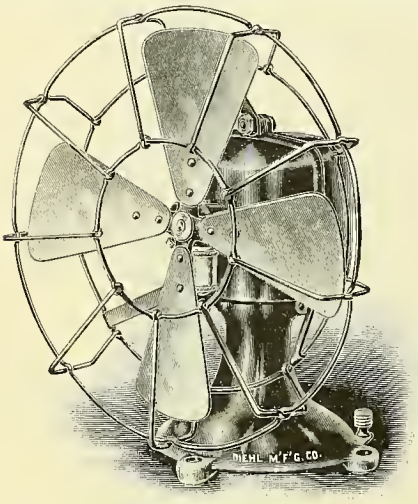
The poles that will not answer the requirements of the companies above mentioned are utilized by this firm for railway ties, fence posts, paving blocks and shingles. Two large shingle mills are operated, cutting 70,000

shingles per day. Cross-arms, oak pins and octagonal poles are also handled, and are made to standard specifications.

W. C. Sterling & Son are extending their business now by getting out hardwood logs, and have established a large general store at Omer, a new town surrounded by forests, through which a railroad has just been built, opening up for them a new territory. This new location is managed by the Squire & Sterling company, of which E. L. Squire is manager.

Diehl Propeller Fan.

The new "propeller" fan illustrated is made by the Diehl Manufacturing company of Elizabethport, N. J. For this fan motor an especially high efficiency is claimed, and it is stated that at 110 volts but .30 to .35 of an ampere of current is required to operate it. The motor has an unbroken magnetic circuit and all wires on the armature or field coils are concealed and insulated by double silk covering. A Carpenter enamel rheostat is mounted in the base, and three speeds may be had. All bearings are self-aligning and self-oiling, and



DIEHL PROPELLER FAN.

the outfit is finished in rich black japan, tastefully ornamented with gilt. The motor is wound for 110 or 220 volt direct current circuits and can also be supplied for lower voltages.

Hunter Fan & Motor Company.

The excellence attained in ceiling fans has probably nowhere been noticed more than in the production of the Hunter Fan & Motor company of Fulton, N. Y. The accompanying cut shows the factory of this concern. About three years ago General Manager J. C. Hunter took up the subject of perfecting an alternating ceiling fan, and in company with Mr. Tuerk devised several patterns. Experiments were made at large expense, extending over a year, before they achieved success. The fan was not offered for sale until it had arrived at a high state of perfection. Since that time it has constantly been the aim of the company to improve its claim to the manufacture of the handsomest ceiling fan on the market. It makes strong claims for the ceiling fan, especially in the matter of economy of power, as it is equipped with self-oiling bearings and adjustable blades, and has a starting switch at the bottom of fan. Special attention is paid to producing a strong, reliable, noiseless, durable as well as ornamental fan. It is finished in bronze, bower, barff, ivory or gold, nickel, and polished brass. General Manager J. C. Hunter reports that the company has been obliged to add very much to the help and machinery in order to prepare for what now promises to be the largest trade it has ever had, and fully double that done last season, notwithstanding the fact that this season has been somewhat backward thus far.

New Curling-iron Heater.

The accompanying cut illustrates a new electric curling-iron heater manufactured by the American Electrical Heater company, 197 River street, Detroit, Mich.

The special feature of this device is its novel and attractive design. This curling-iron heater is built for any voltage, as ordered, and can be attached to any ordinary lamp socket. The small four candle power lamp at the side serves as an indicator to prevent a careless person leaving the current on the heater after use. The dog is of heavily oxidized iron, presenting a fine bronze finish. The lamp, dog and curling-iron rest are supported on a handsome marbleized slate base. One feature of value is that any curling-iron may be used, as, to heat the iron, it is only necessary to insert it in the dog's mouth. This device is not only useful but it is ornamental and well suited for a lady's boudoir, hair dresser's use, etc. This is but one of a number of unique heating

HUNTER FAN & MOTOR COMPANY.

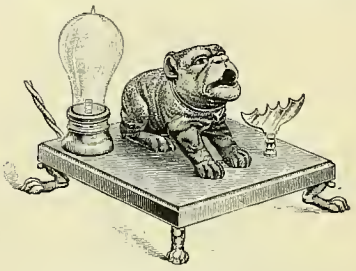
devices now being placed on the market by the Detroit company.

Shelby Electric Company.

The village of Shelby, in Ohio, is conspicuous for several things in the manufacturing world, among which is the Shelby Electric company, manufacturer of incandescent lamps. This company was organized in 1896, and began putting its lamps on the market during the early part of 1897. The vigorous advertising methods pursued by the management of the company brought its name into immediate prominence, and the product has, since the start, been taken far in advance of the capacity of the plant.

The Shelby Electric company is composed of a number of capitalists, who, having been successful in investments in other manufacturing establishments in the village, principally in the steel tube works, which is said to be the largest bicycle tubing establishment in the world, the Shelby Cycle Manufacturing company, which is one of the leading bicycle factories of this country, and the Shelby Mill company, which produces daily nearly 1,000 barrels of flour, thought they saw an opportunity for an investment in the line of incandescent lamp manufacturing, through the chance opportunity of interesting Prof. A. A. Chaillet, formerly of Paris, France. Prof. Chaillet succeeded in demonstrating to these gentlemen and to the electrical engineers whom they consulted that it was possible for him, by using an entirely new method, to produce an incandescent lamp that, he felt confident, would be superior to any on the market.

In order to demonstrate the practicability of making this lamp, this company was organized, and the $100,000 of its stock sold within 24 hours after the investigators had been satisfied that Prof. Chaillet could actually produce the lamp he claimed. The company proceeded very conservatively, building a factory only large enough to manufacture 1,000 lamps a day. That there might be no mistakes, and that the experience of the various factories making incandescent lamps in this country might be taken advantage of, in addition to the knowledge and experience obtained by Prof. Chaillet during the many years he had manufactured incandescent lamps in France and Germany, the company secured the services of Joseph Hardwick, who for a number of years was engaged in the laboratories of the Thomson-Houston Electric company at Lynn, Mass., during which time that company expended a great deal of money in investigating different lamp filaments, and also the services of Charles F. Stilwell, who was intimately connected with Mr. Edison, working with him during the entire period of all of the experimenting at Menlo Park, where the first incandescent lamp was made, and who afterward had entire charge of the Edison fac-



NEW CURLING-IRON HEATER.

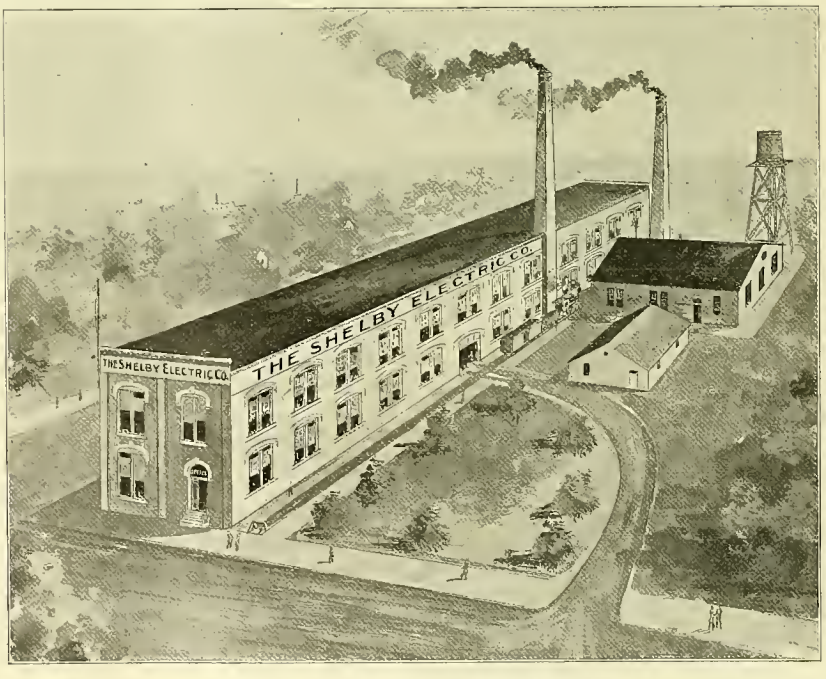
tory manufacturing incandescent lamps at Hamilton, Ontario.

The personnel of any new enterprise is interesting as well as important. For the benefit of those who know the Shelby Electric company only by reputation, the portraits of the men behind it are given, with the following outline sketches:

W. W. Skiles, the president of the Shelby Electric company, is also president of the Citizens' Bank, president of the Shelby School Board, a director of the Shelby Steel Tube company and also a director of the Shelby Water company, and largely interested in the Shelby Cycle Manufacturing company. Mr. Skiles is senior member of the firm of Skiles & Skiles, well-known railroad attorneys.

G. M. Skiles, vice-president of the Shelby Electric company and junior member of the law firm of Skiles & Skiles, is also vice-president of the Shelby Water company, a director in the Citizens' Bank, a director in the Shelby Cycle Manufacturing company, and is largely interested in the Shelby steel tube works. Mr. Skiles is a member of the Grand Tribunal of the Knights of Pythias in the state of Ohio.

M. H. Davis, treasurer, is president of the American



WORKS OF THE SHELBY ELECTRIC COMPANY.

League of Winter Wheat Millers, which office he has held for four consecutive terms. Mr. Davis is also president of the Shelby Mill company and president of the Shelby Water company, a director in the First National Bank and a director in the Shelby Steel Tube company.

J. C. Fish, secretary of the Shelby Electric company, and in whose hands the management of its affairs has been placed, is a director of the Shelby Mill company and a director of the Shelby Water company. Mr. Fish is energetic, and his entire life has been spent in hustling for trade. For the last eight years he has been engaged in the water works department of the John H. McGowan company of Cincinnati, Ohio, as a salesman of water works engines.

A. A. Chaillet, the technical manager of the company, and upon whom it chiefly depends for its advice regarding all points pertaining to the manufacturing of its product, was engaged in the factory operated by his father near Paris, France, when the first incandescent lamp was made by them in Europe. The professor has been engaged as a manufacturer of incandescent lamps since 1878, having had charge of the laboratory of the largest factory in Germany. Mr. Chaillet came to this country in 1892 to manufacture lamps at Marlboro, Mass. He had been engaged in Germany by the Schaefer company to assist it in making filaments and remodeling its plant. This factory was closed by the Edison company shortly after Professor Chaillet had completed his work of remodeling. The professor was then engaged in the designing department of the General Electric company at Lynn, Mass., and has recently completed the design of an electric locomotive for the Jeffreys Manufacturing company of Columbus, Ohio. Professor Chaillet is not only an electrician of extensive experience and knowledge, but is a thorough chemist and mineralogist.

John Cooper Whiteside, A. S. M. E., for a number of years superintendent of the Cooper Engine works at Mount Vernon, Ohio, is the superintendent of the Shelby Electric company. Mr. Whiteside has also made a specialty of electrical engineering, and this, with the mechanical knowledge his long experience has brought him, is a great aid to the company, as it puts him in position to give advice on any point pertaining to an electric plant, in the engine, boiler, or any other part of the plant, or to any difficulty in wiring or any of the electrical apparatus.

Jonas Feighner is one of the directors of the company. Mr. Feighner is one of the most experienced bicycle men in the country, having been connected with the Lozier Manufacturing company of Cleveland, Ohio, for the past 15 years. Mr. Feighner has gained a great reputation as a pusher for trade, and his large experience with the large manufacturing plants in the country has made his advice invaluable to the Shelby Electric company.

Henry Wentz, director, is a man of extensive experience, being also a director of the Sutter Furniture company and secretary of the Mutual Plate Glass Insurance association. He is largely interested in the Shelby Steel Tube company, and is a director of the Citizens' bank. Mr. Wentz is one of the largest owners of real estate in Shelby, having laid out the boulevard, which is the most beautiful residence portion of the town.

Edwin Mansfield, another director, is a member of the law firm of Mansfield & Long, and is also largely interested in the Shelby Steel Tube works and a director of the Citizens' bank.

B. J. Williams, a fourth director, is cashier of the First National bank, a director of the Shelby Steel Tube works and a director in the Shelby Water company.

Each of the four gentlemen last named is well qualified to act as a director of a manufacturing company; they have all been identified with financial transactions of considerable importance.

Joseph Hardwick, the lamp expert, has had a wide American experience, having served with the Thomson-Houston, Columbia and Universal companies.

The intention of the company is not to make lamps to see how cheaply they can be made, but to see how well they can be made; and although the Shelby lamps are new to a great many consumers, the price has been generally maintained from the start. The success of the company thus far has been remarkable, as by the first of March it had received so many orders that it was necessary to begin running nights and to increase the size of the factory, the present appearance of which is shown by the picture on the succeeding page. By the middle of April it was decided by the board to again double the size of the factory, and this was done as speedily as possible, the factory now having an output of 4,000 lamps per day, and the force is still obliged to run nights, but another addition to the factory is contemplated.

1. W. W. Skiles, President.
2. G. M. Skiles, Vice-president.
3. M. H. Davis, Treasurer.
4. John C. Fish, Secretary.
5. A. A. Chaillet, Technical Manager.
6. John C. Whiteside, Superintendent.
7. Jonas Feighner, Director.
8. Henry Wentz, Director.
9. Edwin Mansfield, Director.
10. B. J. Williams, Director.
11. Joseph Hardwick, Lamp Expert.

SHELBY ELECTRIC COMPANY.

The product of the Shelby Electric company is different from that of other manufacturers of lamps, as it makes a specialty of lamps with a tipless bulb of exceedingly high efficiency and long life. The company claims many advantages for its method of production, chief among which is the filament, which is radically different from that used by any other manufacturer, and the method of exhausting, which is said to be much more perfect than that used by any other lamp factory in the country. Each Shelby lamp is tested at its normal voltage for three hours before it is shipped out.

It is interesting to quote a report of the first factory test from a local paper:

The object of the first test was to demonstrate the efficiency of the Shelby lamp as compared with others. To do this, lamps of various makes were operated at the same time to show the difference in brilliancy when burning at their normal voltage and candle power. The Shelby lamp was easily distinguished as the most efficient by everyone present. Not satisfied with this

test, several lamps of different makes were tested in the same manner, in order to select the most efficient lamp to compare with.

The most brilliant lamp of other makes having been determined, it was selected for comparison with the Shelby lamp. The result of the conclusion of this test was watched with great interest by all present, and much to the satisfaction of those interested. The difference in favor of the Shelby lamp was so apparent that no doubt was left in the minds of the most skeptical that the claims made by Prof. Chaillet for his new filament were not only true but could be considered modest in the extreme. The question of efficiency, although one of the most important in connection with the use of incandescent lamps, is not the only one.

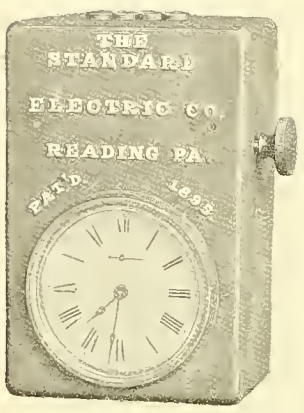
The purchaser of lamps must consider in connection with the efficiency, the length of life of the lamps he buys, as it is perfectly possible to burn lamps at so high an efficiency as to materially shorten the life, thus making the lamp uncommercial. That the remarkable claims of Prof. Chaillet might be verified regarding the life of his lamp at its increased efficiency, the new Shelby lamp and its competitors were burned at a gradually increased voltage constituting what is known as a forced life test.

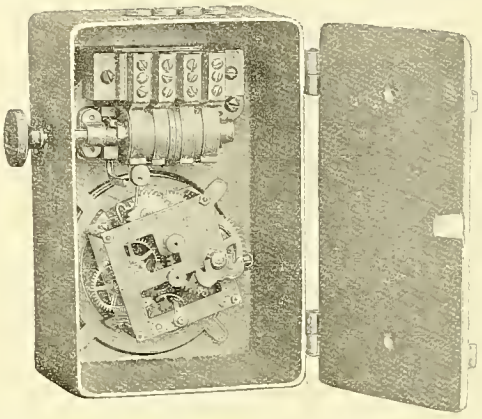
Lamp after lamp of various makes burned out and exploded until the laboratory was lighted alone by the Shelby lamp, not one of the Shelby lamps having been visibly injured by the extreme severity of this conclusive test.

At present the Shelby Electric company is not a member of the lamp pool.

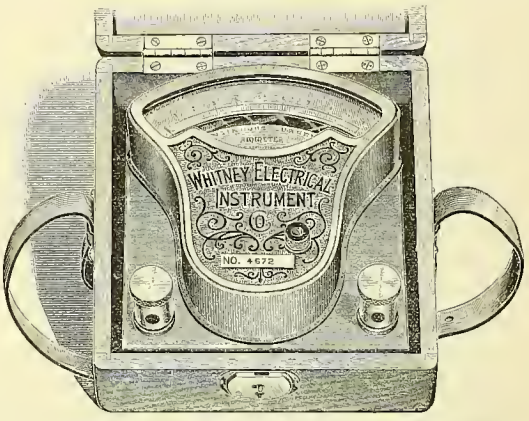
Standard Automatic Time Cut-out.

Many devices have been constructed for cutting-off current automatically, in most cases by the use of magnets, which in course of time proved unreliable and caused their abandonment. The Standard automatic time cut-out, illustrated herewith, is purely mechanical and well calculated to meet all requirements and any demand made upon it up to its carrying capacity. For display windows the merchant will find it invaluable as a saver of current and most convenient for cutting off current at any given time. By means of this switch the consumer is saved the annoyance and inconvenience of going himself or sending another person to the point of consumption in order to break the circuit. On account of the inconvenience of this proceeding, it is seldom done, and the consumer who has his lamps longer in circuit than he needs them, is saved this unnecessary expense. With the Standard automatic time switch in circuit, the consumer has merely to wind the clockwork and to set the "let-off" mechanism, so that it will be released at the desired time; he can then turn on the switch and leave the device to operate automatically. If, however, it is desired to switch off the current before the time determined upon, and perhaps to again complete the circuit, or if it be found desirable to turn on the switch and to turn it off again after the time switch has operated automatically, all this can be done without any interference with the automatic mechanism employed in the switch. The Standard cut-out has been approved by the Fire Underwriters for currents up to 40 amperes and 220 volts. It is made double pole, but can be wired so as to make it a single-pole device as well. The Standard automatic cut-out is manufactured by the Standard Electric company of Reading, Pa., for whom R. E. Difenderfer of 20 North Fifth street, Philadelphia, is general agent.





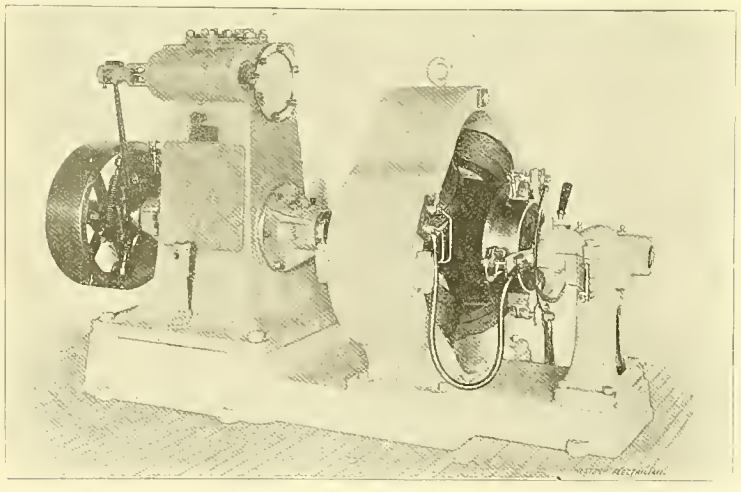
STANDARD AUTOMATIC TIME CUT-OUT.



NEW LINE OF AMMETERS AND VOLTMETERS.

Attractive Direct-connected Set.

An exceptionally compact engine-dynamo unit is shown in the illustration. It is composed of an upright Case engine directly connected to a 15 kilowatt "clover leaf" multipolar dynamo built by the Onondaga Dynamo company of Syracuse, N. Y. These small units are popular where space is limited and an attractive appearing set of high efficiency is desired. The dynamo is of a late design, and is made of this type up to 37½ kilowatts, the company employing the ring type of field yoke for larger sizes. It is pleasing in general appearance, and the manufacturer assures the trade that it is well made in every respect, with well ventilated armature and commutator. The set is said to be practically noiseless. It is operated at a speed of 550 revolutions per minute and weighs about 3,700 pounds.

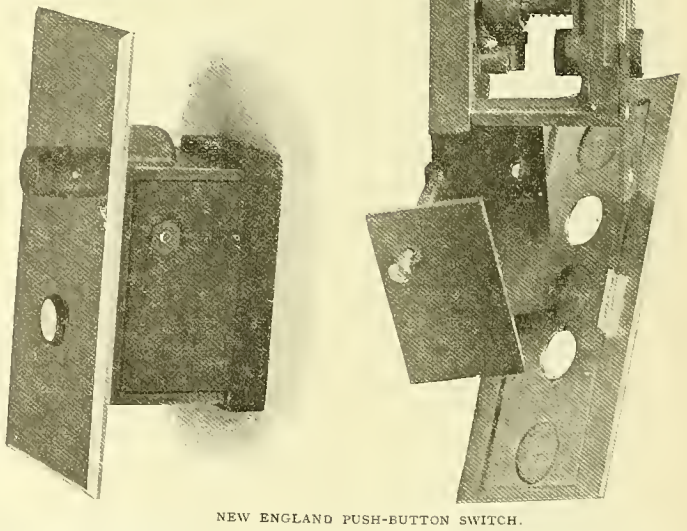


ATTRACTIVE DIRECT-CONNECTED SET.

New Line of Ammeters and Voltmeters.

Appreciating the demand for a reliable but low-priced line of testing ammeters and voltmeters for both direct and alternating current, the Whitney Electrical Instrument company of Penacook, N. H., has brought out a modified form of its well-known Hoyt type. While it is not by any means the intention to discontinue the manufacture of the latter instruments, it has been found that, although giving by far the most accurate method of taking measurements, instruments operated on the dynamometer principle are not as convenient for rapid testing as are the indicating type; hence the new instruments (see cut) are in the latter form and are constructed with especial reference to making them convenient when used as portable instruments. They are mounted upon handsomely finished mahogany bases and covered with neat dust-proof cases of aluminum, while a strong, well-made hardwood outside case with lock and key accompanies each instrument. This case is designed so that the instrument can be used without removing from the case, although it can be readily removed when it is desired to use the instrument for laboratory work.

Both the ammeters and voltmeters will read correctly on alternating current of any frequency as well as on direct current circuits, and there is no appreciable heating error. The ammeters are made in a variety of ranges from one ampere up to 1,000, and the voltmeters up to 10,000 volts, both in single and double scale. These instruments are tested to stand 2,000 volts between the terminals and cap, thus eliminating all danger in the case of grounds on the line. Although the instruments are very compact, occupying a space only six by six inches, they have a scale length of nearly five inches, giving very open deflections.



NEW ENGLAND PUSH-BUTTON SWITCH.

New England Push-button Switch.

Constantly watching the wants of the trade in the line of switches, the O. S. Platt Manufacturing company is continually adding new features to this line of its business. In the last year it has brought out a flush switch which is claimed to be the strongest and neatest switch made, an indicating switch, a cheap knife and a first-class high-grade knife switch—all of which are fully up to the high standard of the well-known N. E. switches.

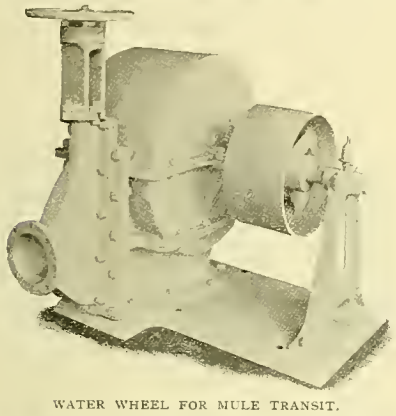
Noticing the need of a good push-button switch, the company has been several months in studying the wants and requirements of a perfect article of this kind, find-

ing that it must be strong, small in size but large in capacity, neat in appearance, easy to work as well as easy and convenient to wire, dust and bug-proof, not too expensive, and as durable as the hinges to the front door. All of these points are thought to be embodied in the New England push-button switch, which is now offered to the trade. As shown in the accompanying cuts, these switches are incased in a solid cast brass housing, perfectly and strongly insulated. Having no porcelain in, on or about them, they can stand any reasonable amount of careless handling without injury; in fact, are practically indestructible. The bases are of slate, and are guaranteed to be free from metallic veins, making them the strongest and safest insulator known, much stronger than porcelain and positively non-absorbent. It will pay anyone who is interested to send to the O. S. Platt Manufacturing company, Bridgeport, Conn., for samples of these switches.

Water Wheel for Mule Transit.

The cut shows the cascade water wheel, built by James Leffel & Co. of Springfield, Ohio, which is intended for foreign shipment, to be located at a point inaccessible to the usual means of transportation. In order that it may be installed under those conditions, the specifications called for a wheel built in such style and proportion that no part or piece should exceed 140 pounds in weight, nor the minimum weight of any piece be less than 120 pounds.

These requirements are successfully met in the wheel



WATER WHEEL FOR MULE TRANSIT.

illustrated. It is intended for a small electric plant of 60 to 200 incandescent lights. The power is regulated by means of a hand wheel and screw, shown in the illustration, that lift a gate which covers three nozzles, affording a wheel of one, two and three capacities of power. Each nozzle can be at will used separately, by means of this gate, or two or three may be used combined.

The lights will be sufficiently steady to admit the use of this character of wheel without an automatic governor, the variation being compensated through the ordinary rheostat. The heavier types of this character of wheel are frequently applied direct to the generators, without belt, which is used in this case. The catalogue of the company shows a plant recently installed of four of these wheels, under 740 feet head, three of which are connected directly to the generators, and the power transmitted a long distance.

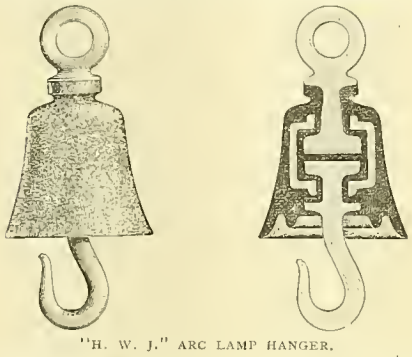
Recent competent and thorough tests, conducted at the Ohio State University, of a 26 inch wheel of this make, shows an efficiency or useful economy of water of 92.36 per cent. A 38 inch wheel, tested at the same time and by the same parties, gave results within .83 of one per cent. of this same efficiency, or over 91 per cent.

The impulse and reaction wheel, to which class this belongs, is being largely used for electric plants, as well as other purposes, since the power can be easily established, or located at inaccessible points, and the current transmitted any reasonable distance, thus making available many powers heretofore considered worthless.

William Porter has purchased the electric light plant at Eldora, Iowa, for $22,500.

"H. W. J." Arc Lamp Hanger.

A new arc lamp hanger, introduced by the H. W. Johns Manufacturing company is constructed after the principles embodied in its giant strain insulator for trolley span wires, insuring great strength and high insulating qualities. The lamp insulator is bell-shaped, with a ring at the top for the hanging cord and a hook at the bottom to receive the ring in the top of the lamp. The cut of the hanger in section shows the arrangement of the ring and hook and the method of insulating these parts from each other and from the metal retaining case



"H. W. J." ARC LAMP HANGER.

by sheet mica and moulded mica, the latter moulded under great pressure and forming the outer covering and the petticoat. The design of the insulator is such that there is ample insulating surface; the breaking strain is 1,000 pounds. The hook is made of malleable iron, which may be bent or closed over the lamp ring if desired. By adopting the giant strain construction the sheet mica supports all tensile strains, the moulded mica fills every crevice and furnishes the best of insulation, and the metal casing prevents any possibility of the hanger giving way and dropping the lamp into the street.

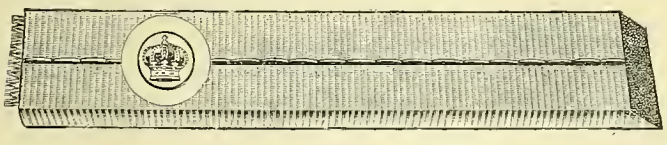
Crown "K" Woven Wire Brush.

The Crown "K" woven wire brush shown in the picture and made by the Crown Woven Wire Brush company of Salem, Mass., is very similar to the imported German brush and is rapidly taking the place of the latter in this country, as owing to the duty on the imported brush the Crown "K" is sold at a much lower price. This company is making a specialty of the manufacture of woven wire brushes and is making everything possible in copper, phospor bronze and alloy. It is at present filling large orders for pencil brushes, to be used in place of carbon brushes on fan motors, etc. The company has recently reduced the prices on alloy brushes.

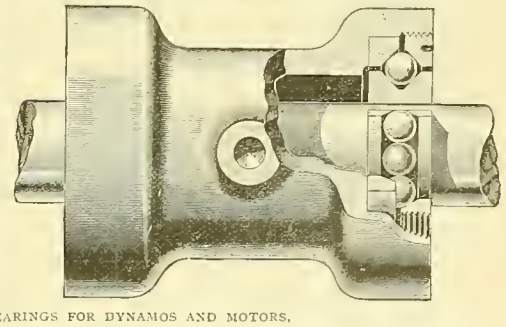
Ball Bearings for Dynamos and Motors.

As almost every moving part of a machine seems likely, sooner or later, to run on ball or roller bearings, it is not surprising to learn that these bearings have lately been applied to electrically driven ceiling fans. Some time ago the Eastman Kodak company fitted up all its ceiling fans, 75 in number, with ball thrust bearings, similar to that shown in Fig. 1, and it now reports that these have given good satisfaction as friction savers. Ceiling fans with this improvement already applied can now be purchased of the Wagner Electric company of St. Louis, which has adopted them in its '97 model. The bearings are manufactured by the Ball Bearing company of Boston, Mass.

The latter company is also furnishing ball bearings for the journals of larger dynamos and motors (Fig. 1). A Westinghouse 20 light dynamo fitted with these bearings is still running after five years of service, and appears to be good for as long a period in the future. No repairs of any sort have ever been made upon it.



CROWN "K" WOVEN WIRE BRUSH.



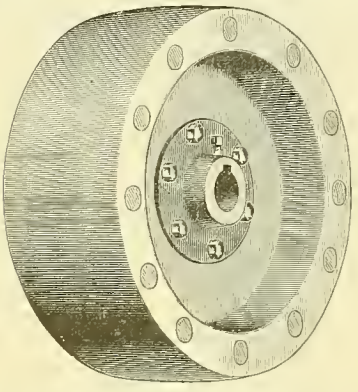
BALL BEARINGS FOR DYNAMOS AND MOTORS.

Rockwood Paper Pulley.

Recognizing that the effectiveness of belted machinery is dependent on a uniform speed, and believing in the unreliability of iron, wooden and covered iron pulleys, and having faith in the superiority of paper over all other low-priced materials, the Rockwood Manufacturing company of Indianapolis, Ind., determined to construct a belt pulley of paper, that would in a large degree, if not entirely, overcome the annoyance and loss occasioned by slipping belts. The accompanying cut illustrates the general form of paper dynamo pulley made by the Rockwood company. Adhesion of the belt is the chief merit of the paper pulley, in which it exceeds an iron pulley in the proportion of four to one; a wooden pulley two to one. Tests made by the Franklin Institute, Philadelphia, show the following results:

Transmission—Iron, 34 pounds; paper, 144 pounds, with equal tension of belt.
Tension—Iron, 150 pounds; paper, 39 pounds, for equal transmission.
Width—Iron, 12 inches; paper, three inches, unsafe for belt.
Diameter—Iron, 48 inches; paper, 24 inches, for equal tension.
Contact—90° on 24" paper equals 180° on 36" iron.

The lighter tension on the belt reduces strains, permitting lighter shafting, hangers, etc., reduces consumption of oil and annoyance and loss from hot bearings. There being no slipping of the belt, there is no wear, and the item of belts in the expense account will be materially reduced. The waste of power and loss of time of employes and bad work due to slipping of belts is obviated. A paper pulley may be relied upon to transmit all the power a belt will carry without a tightener, the belt, not the pulley, being the limit. There being no shrink-



ROCKWOOD PAPER PULLEY.

age strains, as in cast-iron, or numerous pieces, as in wooden pulleys, they may be run at very high rates of speed with safety, and are not easily damaged in handling.

The Rockwood company states that several pulleys in the Brush electric light station in Indianapolis have been in constant use for eight years, giving best results, and are to-day apparently as good as when first put in service. Paper pulleys are not injured by steam or atmospheric conditions, but should not come in contact with water. Paper is of uniform density, and, being turned inside and out, the pulleys are perfectly balanced. They are fully one-half lighter than similar cast-iron pulleys, admitting of lighter shafting and hangers, decreasing cost of plant and maintenance, and being correspondingly easy to put up. Electric light companies report that they get from three to five extra lights, and steadier lights, from each dynamo, by the use of a paper pulley, and on all other high-speed machinery paper pulleys will be found equally advantageous. Paper being a non-magnetic material, paper pulleys are not subject to the attraction of the dynamo magnets, thereby relieving the armature shaft and collars from end strains.

A very simple and interesting test is made by the Rockwood company to illustrate the advantage of the paper surface in contact with a belt as compared with an iron surface. A belt weighted on one end and attached at the other to a spring scale is so arranged as to be thrown first over an iron pulley and then over the paper pulley, which may be revolved by a handle to draw by friction the belt against the spring. The experiment shows the remarkable increase in adhesion of the belt to the paper pulley compared to the iron.

New General Electric Transformer.

A type of transformer of new mechanical design and embodying many marked improvements is announced by the General Electric company. It is known as the type H, following the preceding types in alphabetical order, and its novel construction will be understood from the following:

Fig. 1 shows the construction of the core, built up of

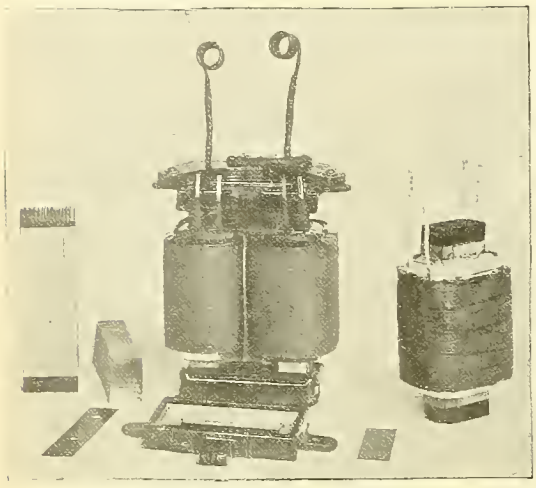


FIG. 1. NEW GENERAL ELECTRIC TRANSFORMER.

single rectangular punchings assembled into a rectangular bundle with notched ends. The bundle compressed under great pressure is compactly held by a casing of insulating material, around which is wound one-half of the low-potential winding, leaving the toothed or notched ends only obtruding. Around this winding is an insulating wrapping, and over it one-half of the high-potential coil is wound. Two such cores and sets of coils, placed side by side with the ends of the cores interlocked into another set of rectangular punchings, complete the interior construction of the transformer.

Winding the coils upon a tightly compressed bundle of iron gives a practically solid mass without possibility of vibration either in iron or coils, and thus eliminates any objectionable "humming" or damage to insulation from constant slight motion of the coils. Still another advantage is the one cylindrical bounding surface between the primary and secondary, doing away with corners or other surfaces inconvenient to insulate. A simple plain cylinder of insulation, composed principally of mica, projects well beyond the winding and separates effectually the primary and secondary windings. This method is consistently carried out in all sizes of the type H, and in the design of the very large ones the dimensions are so proportioned that the necessity of intermixing the primary and secondary windings to obtain good regulation is done away with. The single set of windings is adhered to in all sizes and possible breakdown of insulation almost inseparable from several subdivisions of coils, avoided. To form as strong a barrier as possible against a high potential on the secondary, a protective device is added to the insulation. This is the so-called "earth shield," which is simply a sheet of copper placed between the primary and secondary windings and connected to earth. Thus, even should the insulation between primary and secondary become pierced, this grounded shield would prevent any part of the secondary system being at any great difference of potential from the earth, and remove any possibility of danger to life and property due to high potential on the secondary winding.

The usual type of transformer could with difficulty only be provided with this shield, while with type H the addition is both simple and effective. Fig. 2 shows a 10 kilowatt transformer of this type partially completed, the right-hand core equipped with its shield and another shield standing in front of it. While the General Electric company does not provide this shield in standard transformers, it can readily do so when required.

The relative positions of the iron and copper in the design of the type H is reversed when compared with transformers of other makes. In the usual construction the copper is buried inside the core, and is, therefore, in the hottest part of the transformer, sometimes 75° to 100° F. above the temperature of any accessible part. This is the exact opposite of what is required, as high temperature in the copper means increased resistance, and, consequently, increased drop with reduced efficiency as well as rapid and sure deterioration of the insulation, a moderately high temperature having no injurious effect on the iron core, in fact slightly reducing the loss in it. With coils on the outside and ample clearance between them and the case, a heavy insulating material is not necessary, and any heat can readily escape, two conditions absent when the coils are inside the iron. The type H 60 cycle transformer operates at a lower temperature than any yet introduced.

Fig. 3 is a curve illustrating some of the foregoing facts. All temperatures of the copper were determined by measurements of the resistance of the coils at intervals during the run, and, therefore, denote actual mean temperature of the entire winding. Curve 1 is the temperature of a large sized type H transformer; curve 2, the temperature of the same transformer with the case filled with oil, all type H transformers being in cases designed to be filled with oil; curve 3 shows the temperature of the oil, while curve 4 shows the temperature of a well-known transformer of the same size but of other make; curve 5 showing the highest temperature accessible to the thermometer of the transformer, the actual temperature of which is shown in curve 4.

Fig. 4 shows a group of the standard sizes of type H ready for insertion in their cases. They are uniform, both in proportion and appearance, in the different sizes. Each size has its own special punching, with the result that the entire line is laid out on a perfectly uniform and consistent basis.

Fig. 5 shows the careful design of the case. It is well proportioned; the cover has a deep flange giving a weather-proof joint, the bushings of both primary and secondary leads are of porcelain placed in projecting compartments at the top of the box, which gives protection to the bushing and insures ample distance between primary and secondary. Four secondary terminals are brought through the bushings. The transformer can thus be used interchangeably for either of the two secondary voltages for which it is wound or on a "three-wire secondary" system. A connecting board placed in the case provides for a similar coupling of the two primary coils in series or multiple.

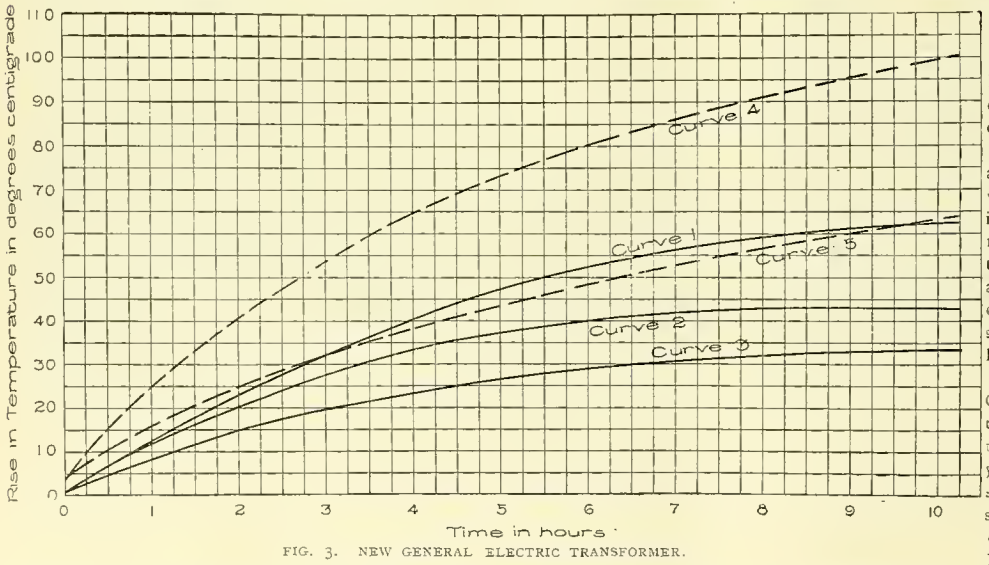


FIG. 3. NEW GENERAL ELECTRIC TRANSFORMER.

To those interested in looking still further into the construction of this transformer and the results that have been obtained with it, the General Electric company would be pleased to send, upon application, a copy of a treatise entitled "Use and Abuse of Transformers." This little pamphlet deals broadly with the transformer question much more thoroughly than is common in commercial literature.

Armorite Factory Moved to Pittsburg.

Readers of the WESTERN ELECTRICIAN will recollect an illustrated article that appeared on December 19, 1896, descriptive of the manufacture of armorite interior conduit. At that time the factory of the Armorite company was in Detroit, and the works were thought to be large enough for the productive needs of the company for some time to come. Those in the electrical trade, therefore, and particularly the supply houses and contractors in the United States who have watched with interest the successful reception of armorite interior conduit by builders, will be surprised at the announcement coming so soon that a demand for that specialty has now reached such proportions that it was found necessary to have greatly increased facilities for its production. Difficulty, too, was found in securing the iron armor for the conduit, and on this account and for other reasons it was deemed a wise move to increase the plant and locate it in Pittsburg. President Cummings of the Armorite company accordingly made an arrangement with the Pittsburg Tube Works through which the Armorite interests obtained possession of a portion of that company's extensive works at Pittsburg, on

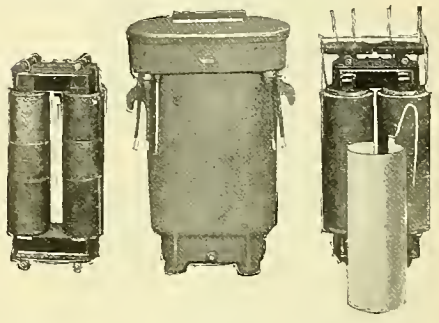


FIG. 2. NEW GENERAL ELECTRIC TRANSFORMER.

Second avenue and Brady street. The portion of the works secured immediately adjoins the tube mill, so that the iron armor comes directly from the machines producing it into the factory of the Armorite company, thus facilitating to a remarkable degree the production of the conduit.

For a number of weeks the Armorite company has been busily at work moving the machinery from the Detroit factory to the new Pittsburg plant, and the concern is now almost, if not quite, ready to turn out conduit in greatly increased quantities.

The company considers this move an important one and greatly to the benefit of its customers in many ways. Located as the company now is, at the source of its supply of iron armor and with its wood-working machinery, etc., to produce the lining of the conduit, at the same point, and the entire factory at such a center as Pittsburg, with its unexcelled transportation facilities north, east, south and west, it certainly seems a very good move, and one that shows wisdom on the part of President Cummings.

It is hardly more than a year ago since James F. Cummings of Detroit appeared in the electrical field as the champion of simple interior conduit or wood-lined tubing, which he had aptly named "armorite." For years Mr. Cummings had been at work developing this specialty, carefully planning every detail and designing special machinery to aid in its production. Woodworkers of much experience when requested to produce wood lining according to Mr. Cummings' specifications had replied, "It can't be done." But to-day it is an undisputed fact that it has been done. The manufacture of armorite is a most interesting process. The conduit consists essentially of an iron tube, usually furnished in lengths of 10 feet, and lined with a basswood tube. The wooden lining is formed in halves, each being tongued or grooved, so that when placed together the tongues and grooves will fit perfectly and the two halves when together form a perfect and tight wooden pipe.

The birth of Armorite, was soon followed by the or-

ganization of the Armorite Interior Conduit company of Detroit. During these days of development a large number of patents were taken out, some of which are owned by the Cummings Conduit company, and some by the Armorite Interior Conduit company. In fact every effort has been made and precaution taken fully to protect, both in this country and abroad, Mr. Cummings' inventions.

The Armorite Interior Conduit company was organized April 3, 1896, and has the following-named officers: James F. Cummings, president and general manager; James Grant, vice-president; John Thomas, secretary and treasurer; William A. Cummings, superintendent.

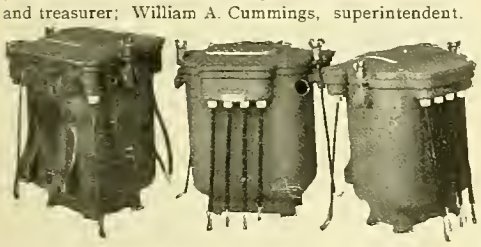


FIG. 5. NEW GENERAL ELECTRIC TRANSFORMER.

The Cummings Conduit company has James F. Cummings as president, W. C. Yawkey vice-president, and T. J. Austin secretary and treasurer.

Those who have watched the progress that President Cummings has made with this simple yet valuable specialty will give him the credit that is his due. Through his indefatigable efforts the business of the Armorite company has grown in the short time of about a year to a point that has exceeded his fondest expectations. There are few, however, that will begrudge Mr. Cummings his success, for it is safe to say that it would be hard to find a man in the electrical business that is better liked.

General Electric Company at the Convention.

The General Electric company will be represented at the Niagara Falls convention in a manner befitting its standing in the industry. The headquarters will occupy the writing room of the International hotel and an exhibit of supplies will be made in the adjacent room. This exhibit will comprise a display of long-burning arc lamps for both direct and alternating current circuits, the latter a recent development. The company will also show a number of focusing lamps for high tension series arc work, as well as long-burning arc lamps for use in series on 220 and 500 volt railway circuit.

The transformer exhibit will include a number of the recently developed type H transformer, and to make this exhibit more effective all the different parts which go to make up the transformer will be shown in detail as well as the cores in the various stages of completion. In connection with this exhibit, the General Electric company will distribute a pamphlet entitled "Use and Abuse of Transformers," perhaps the most complete treatise on this subject ever issued in the form of commercial literature. In addition to this a number of charts will be hung upon the walls of the rooms showing the regulation and other curves of the type H transformer.

There will also be a working exhibit of the Wirt lighting arresters with samples of the latest types for both alternating and direct current work. The meter and instrument exhibit will comprise samples of the latest inclined coil instruments for switch board and portable use, and a series of Thomson recording wattmeters. C. D. Haskins, who has paid especial attention to the question of meters and their use, is expected to be in attendance to explain fully to the delegates the merits of the induction, prepayment, high frequency, station, indicating and regular types of recording wattmeters.

On the tables in the rooms will be a number of fan motors, both for alternating current and direct current. An X-ray set will also be installed at the headquarters, and will be in constant operation.

At the store of F. D. Oliver & Co. the General Electric company will make an exhibit of incandescent lamps and lamp signs, while on the veranda of the International hotel a series of long-burning lamps for 500 volts circuits will serve to enhance the illumination.

Quite an extensive stock of literature will be sent to Niagara Falls for distribution. The souvenir for this year will be a small book descriptive of the Falls, and of the large amount of work the General Electric company has done in its vicinity. Considerable care has been expended in making this souvenir of a character befitting the occasion.

There is a rumor that the General Electric company is preparing something for the ladies, but the convention committee of that company refuses to disclose their plans in this direction.

The General Electric company will be represented by the following named gentlemen: E. W. Rice, third vice-president; S. Dana Greene, general manager lighting department; J. R. Lovejoy, general manager supply department; H. W. Hillman, supply department; H. C. Wirt, engineer supply department; W. L. R. Emmet, engineer lighting department; J. W. Kirkland, lighting department; J. M. Andrews, lighting department, Schenectady, N. Y.; A. D. Page, manager incandescent lamp sales; M. K. Eyre, manager lamp works; John W. Howell, engineer lamp works, Harrison, N. J.; Chas. B. Davis, manager; A. R. Bush, engineer; C. D. Haskins, manager meter department; Fred M. Kimball, manager supply department; S. B. Paine, manager power and mining department, Boston, Mass.; C. F. Esterbrook, supply department, and John McGhie, New York; H. J. Buddy, D. R. Bullen, supply department, Philadelphia, Pa.; John P. Judge, Baltimore office; A. F. Giles, manager, Atlanta, Ga.; J. C. Calisch, Pittsburg, Pa; Thomas H. Fearey, manager; D. F. Potter, Buffalo office; H. H. Crowell, Syracuse office; W. F. Hayes, Edward K. Gillette, L. H. Cooper, Cincinnati, Ohio; T. W. Dixon, Columbus office; Irving Hale, manager, Denver office; F. M. Ray, manager supply department, San Francisco, Cal.; W. D. A. Ryan, Lynn, Mass., office.

Affairs of the Calumet Electric Railway Company.

Judge Showalter, of the United States Circuit Court at Chicago, has authorized John C. McKeon, receiver of the Calumet Electric Railway company, to issue $200,000 worth of receivers' certificates, to bear six per cent. interest and to run until June 1, 1900. The Calumet Electric is the principal asset of the National Bank of Illinois, and Mr. McKeon as receiver of the latter will advance himself money out of the bank's cash on the certificates he will issue as receiver for the road. Though this action will hold off the next dividend on Illinois National depositors' claims for a longer period than would ordinarily be necessary, it will best conserve the interests of the depositors, as the receiver will not have to sacrifice the certificates at a price below par in order to get ready cash. Among the uses to which proceeds of the certificates will be put are the payment of current obligations and pay rolls, miscellaneous current claims, Paige Iron works claim, Pullman Palace Car company claims on account of lease of Pullman electric railway and purchases of cars. An appropriation of $86,052 is made for repairs, work and extensions, including improvements in the motor equipments and power plant.

PERSONAL.

H. E. Shedd, city electrician of Elgin, Ill., was a Chicago visitor last week.

Frank L. Marr, president of the Helios Electric company of Philadelphia, was in town last week.

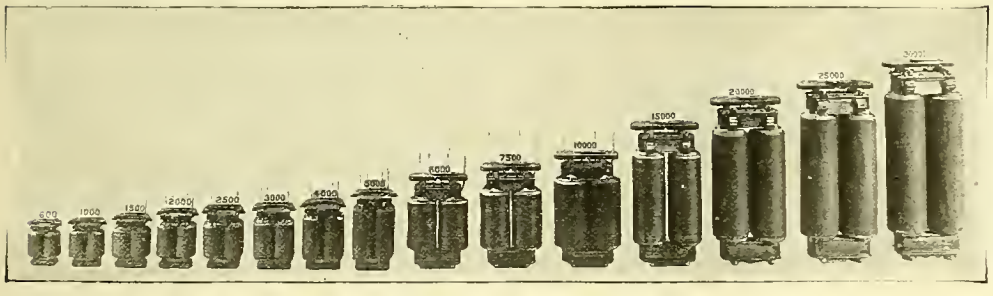


FIG. 4. NEW GENERAL ELECTRIC TRANSFORMER.

Thomas R. Mercein, secretary of the Northwestern Electrical association, while in Chicago last week announced that the organization had gained many new members during the last few months, one application coming from Denver.

ELECTRIC LIGHTING.

The contract for furnishing and installing an electric light plant for Graceville, Minn., was let to J. & W. A. Elliott of Minneapolis for $4,496.

A special election was held in Geneva, N. Y., recently for the purpose of awarding the street lighting contract. The one-year contract of the Geneva Brush Electric Light & Power company received the majority of votes, 226 for and 13 against. An investigating committee, for the purpose of investigating the question of municipal ownership of an electric light plant, was also voted for, the vote being 162 for.

ELECTRIC RAILWAY.

Director Raymond of the National Railway company, an Illinois corporation which controls the street railroad business of St. Louis, says that earnings of that company so far this year have fallen off somewhat below the record of 1896. In that year the company earned 9.22 per cent. on its stock. The falling off so far has not been heavy enough to suggest a reduction of the dividend rate, which, according to Director Raymond, is likely to continue six per cent. The outlook he considers fairly favorable for the latter part of 1897.

TRADE NEWS.

William Hubbard of Elgin, Ill., claims the distinction of being the first independent manufacturer of and dealer in telephones. The Elgin telephone has held its own and is growing in popular favor.

The National Automatic Fire Alarm company of Louisiana is now going into the general electrical supply business, handling electric light, telephone and house goods supplies, putting in a complete line of these goods. It will be glad to receive catalogues from manufacturers. E. H. McFall is general manager of the company.

The Peerless Rubber Manufacturing company of New York is sending out circulars descriptive of its chief specialties, Rainbow, Honest John, Hercules and Peerless packings, as well as of the Eclipse sectional rainbow gaskets. These circulars contain much that is interesting to the trade, especially to purchasers of this class of supplies.

The New York office of the Electric Storage Battery company of Philadelphia has been moved to new quarters, rooms 904 and 906 Commercial Cable building at 20 and 22 Broad street. This change has been necessitated by the rapid growth of the New York business, for which General Manager Blizard of this office has reason to feel justly proud.

The Maxwell House, Nashville, Tenn., is increasing the electric light plant by the addition of a 115 horse power engine direct-connected to a General Electric dynamo. The engine was built by the Ball Engine company, Erie, Pa., and is the third engine furnished by the company for this hotel. The Rockville Water Works, Rockville, Md., is installing an electric light plant, the engine for which was furnished by the Ball Engine company.

A. M. Morse on June 1st removed from 1249 Marquette building, Chicago, to suite 1108 and 1109 in the same building. He will make a specialty of high-grade engines for electric service, both Corliss and high-speed types. Mr. Morse has had a wide experience in steam engineering work and has equipped many of the representative power plants of the Southwest. For the last five years he has been the selling agent of the Buckeye Engine company for the St. Louis and Chicago territory, but severed his connection with that company June 1st.

The Chicago Belting company takes considerable pride in a letter received some time ago from the Louisiana Electric Light company, New Orleans, La., which has the distinction of using what is said to be the largest belt in the world. This belt is 143 feet long by 84 inches wide. After almost a year's use the Louisiana company does not hesitate to state that it is all the makers claim for it. The users state that it has never given a moment's trouble, always running true and straight, although it has carried a load of 1,800 horse power. Many similar testimonials have been received from other users of belts made by the Chicago Belting company, for which exceptional claims are made. The company has received more than its share of business within the last few months.

A representative of the WESTERN ELECTRICIAN recently visited the Commercial Electrical Supply company of St. Louis, and found the company busily engaged in pushing general supplies, and especially the spring fan business. Notwithstanding the backwardness of the season, the company has done an extensive trade in fans; in fact, the management states that one-third more fans have been sold this season than was the case last year. Ceiling and desk fans have been the most in demand. The Commercial company also announces the fact that it has just closed arrangements whereby it is to push the Helios arc lamps. As is well known, the Helios "inclosed arc" has a number of valuable features, which the Commercial company's customers will do well to investigate. The company is now busily at work finishing a very complete catalogue. This will be a very handsome and thoroughly comprehensive work, and one that should be in the hands of every buyer of supplies

BUSINESS.

The Boston (Mass.) Motor company's 1897 catalogue, containing several tables and other valuable information, also a full list of motors for battery, alternating and direct current X-ray apparatus, and experimental electrical supplies, will be sent to those interested on receipt of stamps for postage.

The Electric Appliance company desires to call particular attention to the fact that it has recently increased its stock of porcelain goods to the point where it claims that it now carries the largest and best assortment of porcelain insulators, tubes and cleats in the West. The stock includes several hundred different styles of porcelain insulators, brackets and cleats, and is certainly a most complete stock of porcelain goods.

The Farr Telephone & Construction Supply company, 342 Dearborn street, Chicago, has just issued a complete and interesting catalogue of telephones, telephone supplies, etc, which everyone interested in telephone work will find of interest. The catalogue, which is also a

hand-book of information, contains a number of diagrams, with instructions for connecting up telephone lines, bells, batteries, etc. It is profusely illustrated. Copies may be had on request.

The Adams-Bagnall Electric company has recently closed a deal by which the company will confine itself exclusively to the manufacture of arc lamps, having sold the incandescent business and factory. The former manager, Mr. Rogers, and Mr. Arnold of the engineering corps, have retired to engage in the incandescent lamp business. The Adams-Bagnall company has moved into much larger quarters, which gives it nearly double the previous capacity and the manufacturing facilities which experience showed would be desirable.

H. M. Underwood & Co. of Chicago have secured many valuable agencies for the western territory. They are general sales agents for the United States for the Cloos junction box, and they have only recently been made Chicago agents for the Belknap Motor company, Portland, Me. Mr. Underwood has been in the electrical business since 1884, and has been connected with many of the largest electrical companies. The Belknap Motor company may be congratulated in obtaining the services of such an enterprising representative and one who has many staunch and influential friends in the trade who will not leave a stone unturned to throw business in his way whenever an opportunity presents itself. It will be remembered that when the system of conduiting buildings first came out Mr. Underwood was among the first to take up this branch. He was then with the Interior Conduit & Insulation company, New York, and he came to Chicago in 1891 as general sales agent for that company. He was the first person to install an automatic telephone exchange for public use. This was for the Strowger Automatic Telephone company, in November, 1892.

The following list of valuable agencies would seem to indicate that S. F. B. Morse & Co. have been during the last few months actively at work extending their already rapidly increasing business: Medbery electrical railway material and switches, Gordon-Burnham primary batteries, iron clad rheostats and theatre dimmers, "Globe" high grade incandescent lamps, "Pioneer" enclosed arc lamps for incandscent circuits, Hope Electrical Appliance company of Providence, R. I. specialties. Of course it is well-known that the chief specialties S. F. B. Morse & Co. are high grade insulated wires and cables. S. F. B. Morse the senior member of the firm is one of the most popular and successful wire salesman in the West. In fact it is safe to say that few men are more popular with heavy buyers of high class insulated wire and cable than he. J. D. Earle, the the junior member of the firm, has recently associated himself with Mr. Morse under the firm name of S. F. B. Morse & Co. and together these gentlemen constitute a team that will be hard to beat. Mr. Earle is a Boston man who has recently come to Chicago. In the business of S. F. B. Morse & Co. he will attend largely to the office affairs of the concern while Mr. Morse will, as has been his custom, engage actively in pushing the sales of the various specialties. There is no change in the location of the headquarters of the institution. "Morse" and Earle can always be found at the "old stand," 1015 Marquette Building, Chicago. It has long been Mr. Morse's desire to add to his specialties, wires and cables, a number of other valuable and high class electrical specialties for the reason that he believes that his large acquaintance among buyers in the West would be valuable in pushing a few other parallel special lines as well as the wire business alone. With two men so well fitted for the respective branches of their business it is fair to presume that the new organization will prove as successful as the old one.

One of the most attractive pamphlets that has been issued to the trade in many months is that which deals with "Use and Abuse of Transformers," a product of the advertising department of the General Electric company. The reasons that prompted the publication of this treatise at the present time is explained by the publishers: Distribution of electrical energy by transformers, coming into use as it did at a time when electrical plants were being installed rapidly and the whole electrical business was being exploited in a most vigorous if unsystematic manner, was not, in the early stages of its development, closely criticized by the users; it was sufficient that this method accomplished results which could not be obtained in any other way. At the present time, when the electrical business has settled down into more conservative lines, it is of the utmost importance to look over the field, and to view without roseate spectacles the qualities of the apparatus upon which the success of many electrical enterprises depends, and especially to see what has been done in improving such apparatus and rendering it more desirable and economical to the purchaser. We may divide the discussion into three parts: The essential properties of alternating current transformers, proper and improper methods of distribution, results obtainable by exchanging bad methods for good. The pamphlet contains much new information and much that has already been printed, but it is presented in such compact and attractive form that it cannot fail to be useful to central station managers.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 1, 1897.

583,452. Electric Switch. Thomas H. Brady, New Britain, Conn. Application filed February 1, 1897.

A pair of circuit terminals and a lever handle, which is provided with a terminal disk, and is pivoted thereby between the parallel cheeks of one of the terminals, the disk being of uniform thickness equal to the distance between those cheeks, in combination with a circuit-closing blade, which is of the same uniform thickness between those cheeks, and is adapted to turn on the disk as a pivot.

583,507. Gas Engine. John W. Raymond, Racine, Wis. Application filed January 13, 1896.

An electrode is adjustably and removably secured to the distributing valve, and a second electrode is removably engaged within an aperture of the cylinder wall.

583,513. Electrolysis of Watery Salt Solutions Wilhelm Spilker, Berlin, Germany. Application filed August 15, 1891.

In the electrolysis of watery salt solutions the process for the production of endosmotic membranes for use in the electrolysis by the electrolysis itself consists in separating, by means of a membrane serving as a foundation diaphragm, an alkaline cathode solution from an anode solution consisting of a mixture of the chlorides of the alkali metals and calcium holding the corresponding oxyhydrate caustic lime in solution, and causing a solid porous coating to be firmly attached to the foundation membrane on the side of the anode space by passing an electric current through the bath.

583,524. Underground Railway Conduit. Albert G. Wheeler, New York, N. Y. Application filed March 5, 1896.

A slotted conduit, comprising transverse yokes, slot rails bolted to the same, and guide rails which are secured in place by being inserted between the slot rails and the yokes.

583,525. Electric Railway. Albert G. Wheeler, New York, N. Y. Application filed March 5, 1896.

A supporting bar is provided, and a traveling contact device is carried by the bar; a guide flange is mounted on the bar and provided with a sleeve which slides endwise on the bar, and which is supported in position by the parts at the lower end of the bar.

583,575. Collector for Electric Railways. Louis J. Hirt, Brookline, Mass. Application filed September 6, 1895.

A frame is suspended from the car, with a series of contact plates on each side of the frame and insulated therefrom; conducting strips whereby the current is conveyed from the contact plates through the collector, and the insulator between the series of contact plates on each side of the frame.

583,586. Electric Igniter for Gas Engines. George Westinghouse and Edwin Ruud, Pittsburg, Pa. Application filed September 22, 1896.

Two movable electrodes are mounted in the cap or bonnet, each adapted by its movement to make and break a circuit, and an actuating mechanism is provided for operating either of the movable electrodes.

583,589, Electric Connector. Frank E. Austin, Hanover, N. H. Application filed January 7, 1897.

An insulating casing and elastic closing plugs for the same are provided with pin-hole apertures for the insertion of the ends of the conducting wires, and a conducting amalgam in the casing is adapted to establish an electrical connection between the inserted ends of the wires.

583,618. Vacuum Electric Arc Furnace. Hilliary Eldridge, George H. Wright and Daniel J. Clark, Galveston, Tex. Application filed February 24, 1896.

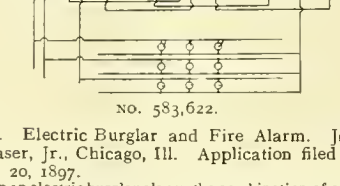
A cylindrical pot-cathode and a hollow cylindrical anode are supported for vertical adjustment within the cathode, and of a diameter nearly equaling that of the cathode to form a receptacle for holding the substance to be fused, and so as to lie in sufficiently close proximity to the sides of the cathode, whereby an arc will be maintained between the adjacent sides of the anode and cathode.

583,622. System of Electrical Distribution. Peter M. Heldt, Chicago, Ill. Application filed November 16, 1896.

In a system of electrical distribution, the combination of a source of tripbase current, with primary coils in circuit therewith and a plurality of secondary coils in secondary circuits disposed in substantially equal inductive relation to each of the primary coils.

583,630. Electric Gas Lighter. John Y. Parke, Philadelphia, Pa. Application filed January 2, 1897.

There is a fixed electrode near the burner-tip; a pendent lever is operatively connected to the gas-cock; an electrode is carried by the pendent lever, and a curved spring has two arms normally tending to separate, the ends of the arms being secured respectively to the burner and to the lever, and tending to hold such lever in either of the two positions to which it may be moved.

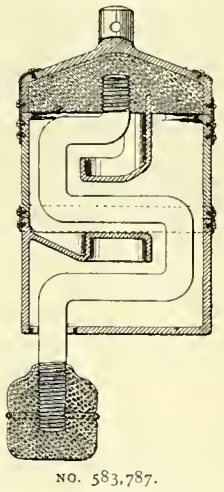


NO. 583,622.

583,644. Electric Burglar and Fire Alarm. John R. Fraser, Jr., Chicago, Ill. Application filed February 20, 1897.

In an electric burglar alarm the combination of an alarm-sounder in a normally closed circuit, including the windows or doors to be protected, and containing a high resistance section, a normally open branch circuit including said sounder and containing a low-resistance section, and means for closing the branch circuit by opening the high-resistance circuit.

583,672. Conduit. Adelbert L. Daniels, North East, Pa. Application filed February 10, 1896.



NO. 583,787.

A conduit consisting of an inner clay tube composed of short lengths or sections, an outer wrapping of wire or tape, and a coat or layer of waterproof material between the tape or wire and the clay tube.

583,692. Insulator. Edward Renault, Waldo, Fla. Application filed January 20, 1897.

An insulator comprising a pin or support, having the clamping members formed integral therewith, an insulating bulb formed with the circumferential groove, in which the members fit, the bulb being provided with the interiorly toothed sleeve, through which the wire passes and is held by the teeth, and the set-screws located above and below the bulb for securing the clamping members together.

583,704. Switch and Trolley for Overhead Traveling Apparatus. Gustav Henkel and Gottfried Scheld, Cassel, Germany. Application filed November 7, 1895. Patented in Austria October 12, 1890; in England May 30, 1894, and in Hungary June 12, 1894.

An overhead trolley switch is described, consisting of meeting webbed and flanged rails arranged with intervening spaces between the flanges at their points of intersection, and having transverse passages in the adjacent webs, combined with a trolley carriage having its sides adapted to pass through the spaces between the meeting flanges of the rails and provided with wheels adapted to run upon the flanges, and a suspension device connected with the carriage.

583,718. Electric Water Filter. William L. Teter, Philadelphia, Pa. Application filed June 19, 1896.

A process is described consisting in forcing the liquid in minute streams or jets against a positive metallic electrode, and in its divided state subjecting each jet to the action of a current of electricity, then forcing the water up through a filtering medium, and at the same time passing a current of electricity through the water.

583,787. Electric Insulator. William Christie, San Francisco, Cal. Application filed February 16, 1897.

This device comprises a metal casing having a bottom closure provided with an opening near one side, an insulating material secured in the upper portion of the casing, a zigzag suspending rod extended through the opening in the bottom closure and having connection with the insulating material, and a cup-shaped condensing plate arranged in the casing between the central and upper horizontal portions of the suspending rod.

583,810. Secondary Battery, Joseph H. May and Frank King, London, England. Application filed January 26, 1897.

The method of applying a coating of india rubber to a cover or envelope for secondary batteries consists in first treating the cover or envelope with a solvent of the material composing it, and applying to it while in a soft condition a coating of india rubber.

583,820. Fusible Socket for Electric Lamps. Samuel H. Russell, Watsonville, Cal. Application filed December 7, 1896.

The fusible socket for electric lamps described consists of the cylindrical body and disk-like base, the body being provided with a series of recesses in its peripheral face, standards in electrical union with each other connecting the body and base, poles or angle-plates recessed in the upper part of the body and in electrical union with the lamp, fusible links connected to the poles, means for connecting the links with the source of electric energy and for opening and closing the circuit.

583,838. Fire or Burglar Alarm. Desmond O. Benjamin, Lawrence, Kan. Application filed January 12, 1897.

In an alarm, the combination with a mainspring and an arbor therefor, of the master-gear attached to the arbor and carrying a detent, a spring-controlled trigger pivoted adjacent to the master-gear and adapted to engage with the detent thereon, a counter-shaft geared to the master-gear, a bell-striker mechanism, multiplying gearing between the bell-striker mechanism and the counter-shaft, and means to free the trigger from engagement with the detent on the master-gear.

583,880. Electric Brake. Rudolph M. Hunter, Philadelphia, Pa. Application filed July 14, 1885. Divided and this application filed October 1, 1891.

The first claim is given: An electric brake consisting of the combination of the axle, the longitudinal sliding core encircling the axle and having conical friction beads, and a solenoid or helix having a stationary frame with a conical socket adapted to receive the conical head of the core.

583,881. Self-adjusting Trolley. Charles S. McIntire, Allegheny, Pa. Application filed February 19, 1895.

There is the combination with the trolley arm and wheel of a forked replacing device adapted to slide longitudinally upon the arm and means for raising and lowering it for replacing the wire in the groove of the trolley wheel.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, JUNE 19, 1897. No. 25

Samuel Insull, President National Electric Light Association.

In selecting Samuel Insull for the presidency of the National Electric Light association the organization secured an active and energetic executive officer, and ensured a progressive policy during the ensuing year. This action on the part of the national association, it is thought, will go far toward modifying the feeling of western members that this section of the country is not being properly recognized, and of harmonizing many other conflicting interests. The fact that Mr. Insull is now president of the Association of Edison Illuminating Companies, will, it is believed, have the effect of promoting friendly relations between the organizations, and securing co-operation in all matters affecting the industry

The new president of the National Electric Light association, whose portrait is here presented, has been prominently identified with the electrical interests for many years, and he is especially well known to all who have been engaged in the development and management of the Edison interests. He is a native of England, but has been a resident of the United States for 16 years. He was born in London on November 11, 1859, and came to this country in March, 1881. He had been actively engaged in promoting Mr. Edison's European interests before coming to this country, especially in the field of telephony, and had been associated with Edward H. Johnson in this work. It was through the latter gentleman's solicitation that Mr. Insull came to this country to act as private secretary for Mr. Edison. From the beginning their relations were extremely cordial, and it was not long before Mr. Insull assumed the entire responsibility of management of Mr. Edison's business affairs. Those who are acquainted with the character of the inventor will readily understand the willingness with which he relieved himself of all the care and worry of the routine of business. For many years Mr. Insull acted in confidential advisory capacity to Mr. Edison, and his intimate knowledge of the latter's affairs enhanced the value of his advice and assistance. This was especially apparent during the period in which Mr. Edison developed the incandescent lamp and made it commercially successful. The Edison shops, which comprised the three or four enterprises which Mr. Edison controlled, were conducted under the personal supervision of Mr. Insull. It was during this period that Mr. Insull gained the intimate knowledge of the manufacturing business which has since stood him in hand. The Schenectady works, which were opened on Christmas day in 1886, were built during Mr. Insull's administration, and were run by him until the organization of the Edison General Electric company.

In the formation of that company Mr. Insull was made second vice-president, and was placed in charge of the manufacturing department. Not long after this he was given charge of the selling department also, and was thus placed in absolute control of the company, aside from the financiering of the institution. During this time the business developed at a remarkable rate, and when the Edison General Electric company was consolidated with the Thomson-Houston interests in the General Electric company the business of the Edison company amounted to $10,000,000 a year. When the General Electric company was formed Mr. Insull was elected second vice-president, but he immediately resigned, and really had no part in the management of that corporation. He was immediately tendered the presidency of the Chicago Edison company, and has ever since directed the affairs of that corporation. When he took charge of the business of the Chicago company its capital stock was $750,000, and in comparison with its present business it did not cut much of a figure in the financial and industrial world. It has since developed at a rapid pace, and to-day the company's securities aggregate $8,500,000 and its business is correspondingly improved. The annual statement of the company, which was submitted for the consideration of stockholders at the annual meeting on June 14th, has already been alluded to in this journal. The figures there presented show that the gross earnings of the company during the last fiscal year were $1,548,608.10, and the amount of current supplied by the company's system was equivalent to connections for 355,140 sixteen candle power lamps

Mr. Insull has always shown a great interest in the Association of Edison Illuminating Companies, and at present occupies the office of president of that organization. His election by the National Electric Light association would seem to indicate that the hostility which once existed between these associations has been supplanted by a kindlier feeling, and there can be no doubt that the industry will be greatly benefitted thereby.

Mr. Insull has been singularly successful in his business undertakings, which may be partly attributed to his splendid executive abililty and his perseverance and intelligent application, although he himself is inclined to attribute it largely to the opportunities placed at his disposal by Mr. Edison. His faith, admiration and warm devotion are centered in the great inventor, and he is happiest when singing the praises of his old companion. He regards Edison as one of the master minds of the age—probably the greatest "commercial inventor" the world has ever produced. It may be appropriately added that Mr. Edison reciprocates the feelings of friendship, confidence and admiration for the friend who watched over his interests so carefully and left him free to devote all his time and energy to the work in which he was then engaged.

SAMUEL INSULL, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

Street Railway Legislation at Springfield.

After fierce opposition, the Allen bill regulating street railway corporations was passed by the Illinois Legislature, and it became a law by the signature of Governor Tanner on June 9th. The bill has been widely discussed, and the members of the Legislature who supported it, as well as the governor, have been severely criticised. The latter makes this explanation:

There are but two questions in the Allen bill, I find, after examining it most carefully. One gives city councils the power of granting franchises and extensions to street railway companies not exceeding 50 years. I do not think that feature at all objectionable, and believe the term is not unwarranted. The bill allows or rather declares, that for the period of 20 years the fare shall be five cents. This is an arbitrary provision. After 20 years the Council fixes the fare. Now some of the franchises expire in six years and others in 19, so that the average term of expiration is 13 years at a five cent fare. The extension, therefore, of the five cent fare period is but seven years, and I do not think this is out of the way. The bill in no sense of the word deprives the Common Council of power.

This body can extend the franchises if it wants to, or it may refuse to do so. The bill is silent on the question of compensation, but everybody knows that no such ordinance as this would be granted, especially in the large cities, without proper compensation, based on the gross earnings of the corporation, The Council will fix this percentage, which may be three or five, or whatever the body may dictate. I am a firm believer in the principle that corporations should pay a percentage of their gross receipts into municipal or state treasuries. This principle was recognized in Illinois when the charter of the Illinois Central railroad was granted. It has worked well in that instance, and will doubtless do so in others. I hope to see the day when the corporations of the state will bear the greater part of state and municipal taxation, and this Allen bill is a step in that direction.

The street railway interests of Chicago, under the leadership of Mr. Yerkes, were active promoters of the bill. The stocks of the three leading companies were favorably affected when the news of the governor's signature became known.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Mutual Telephone company of Des Moines, Iowa, is receiving supplies of apparatus, poles, etc., and will begin at once putting up service wires and instruments.

The Iowa Telephone company has accepted the 10-year franchise offered by the city of Newton, Iowa, and will establish an exchange there. Supplies for the American Telephone & Telegraph company are being received at Newton also, and it is expected to have service there in a few weeks.

Business men of Guttenberg, Iowa, propose to build a telephone line to Millville and connect there with Cassville, Wis., and Dubuque, Iowa.

The Iowa Telephone company has adopted a new way of digging postholes on its long-distance lines. A hole is dug two feet, of the desired diameter, and then a drill is sunk through the center of the hole three or more feet. A piece of dynamite is then put in the drilled hole, tamped and exploded. The result is a five foot hole almost round and as clean as though dug with a shovel. About twice as many holes can be dug in a day as by the old method.

Work is being hurried on the new telephone exchange at Aledo, Ill.

A telephone line from Winthrop, Minn., to connect with the Twin Cities via either Gaylord and Arlington or New Ulm is urged.

The Little Wolf River Telephone company has been incorporated at Weyauwega, Wis., with $6,000 capital stock. It includes in its territory Waupaca, Winnebago, Waushara, Shawano, Langlade and Brown counties.

The county commissioners of Wabasha county have granted a right of way through the county for telephone lines to W. T. Adams of Elgin.

The American Telephone & Telegraph company expects to have long-distance connection across Iowa with Omaha in 30 days.

An effort is being made to form a farmers' telephone line near Garnavillo, Iowa.

The Dakota Central Telephone company has shipped materials for the extension of its line from Redfield to Huron and Doland, S. D.

The Iowa & Dakota Telephone company has brought suit against J. A. Barnsback and others at Vermillion, S. D., to recover an amount claimed to be due on a contract signed by the defendants. The defendants claim that the contract called for an automatic telephone exchange, which the company failed to put in.

THE CONVENTION

Of the National Electric Light Association at Niagara Falls, June 8, 9 and 10, 1897.

The twentieth annual convention of the National Electric Light association at Niagara Falls will linger in memory for many years as one of the most notable gatherings the association has held. The papers presented bore on subjects of marked interest, and brought out earnest and instructive discussion. The unusually large attendance was another evidence of the vigor of the association.

The headquarters of the association were in the International Hotel, and it was there Secretary Porter had his office, which was opened early for the registry of the members and for the purpose of dispensing information to all who desired it. The weather on Tuesday and Wednesday was wet and cloudy, but the final day of the convention dawned brighter, and afforded opportunity for pleasant drives to the various points of interest about the Falls.

In advance of the opening session of the convention the executive committee held a meeting, and it was 10:45 A. M. on Tuesday, June 8th, when President Nicholls sounded the gavel calling the convention to order. He invited First Vice-president Henry Clay of Philadelphia and ex-Presidents Armstrong and Ayer to the platform, after which he read letters from the Niagara Falls Power company, the Niagara Falls Hydraulic Power & Manufacturing company, the Buffalo and Niagara Falls Electric Light & Power company, the Carborundum company, the American Telephone & Telegraph company, and from B. E Greene, rental agent of the Grand Central Palace, New York. Letters of regret were received and read from Prof. Edward L. Nicholls of Cornell University; Sir William Dawson, McGill University, Montreal; Prof. Henry T. Boves, Montreal, and from Lord Kelvin of Glasgow University, Glasgow, Scotland. A letter from William S. Aldrich of West Virginia University was also read.

President Nicholls then delivered his address, which was listened to with close attention, and his remarks were frequently applauded.

President Nicholls' Annual Address.

In arriving at a decision as to the most suitable place at which to hold the twentieth convention of the National Electric Light association, the executive committee and your president were guided largely by the desire to select a spot where our members could have some practical illustration of the most recent advances in electrical development as applied to everyday commercial use on an extended scale.

Niagara Falls, N. Y., appeared to offer superlative inducements as our place of meeting, judged by this standard, and was accordingly given the preference; and with a knowledge of the programme that has been prepared for the instruction of our members and the many interesting features for the entertainment of themselves and their friends, I am confident that before the close of the convention those present will unanimously be of the opinion that our choice was wisely made.

When we consider that only five years since many of us were in attendance at the fifteenth convention of the association held in Buffalo, and were listening to the discussion which followed Dr. Carl Hering's paper on "Transmission of Power," and that even the most sanguine of us but little imagined that in half a decade we should be holding our twentieth convention at Niagara Falls, principally with the object of seeing and realizing the actual application of motive power derived from the Falls to some of the most novel and most important industries of the country, we face a wonderful accomplishment. To "harness Niagara" had long been a dream, but is now an actuality; and who can tell the resultant progress and advancement that we may be destined to celebrate within the next few years?

There is no parallel in history for such rapid development of any industry as that of the manufacture of electrical apparatus and its application, or to be strictly correct, and quote an ex-president of the association, M. J. Francisco, who is an authority on the subject, the only parallel was when the world was created in six days out of nothing. Five years ago we were discussing the possibilities of transmitting power in small units to moderate distances. To day the problem is solved, and innumerable installations are transmitting power in large quantities for long distances, and yet we have only crossed the threshold.

In this connection I am of the opinion that the lecture to be given to-morrow evening by L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo; Mr. Stillwell's paper will set forth the various applications of Niagara power at the present time, including transmission to Buffalo; and future presidents of this association will in all probability refer to his paper and draw comparisons when advertising to the strides which will then have been made in the wider utilization of this mighty power which for countless ages has been simply running to waste, so far as any economic use is concerned and apart from its value as the greatest scenic wonder in the world.

I fully appreciate the honor of presiding at this meeting, which, for the reasons I have just referred to, will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry, and it is therefore with more than ordinary satisfaction that I am authorized to state that at no previous period has this association been so prosperous, shown greater vitality or commanded such respect. It is now an acknowledged authority on matters electrical; its membership confers a privilege that has more than a sentimental value and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection.

In union is strength and to-day our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the finance committee will show that, after making provision for all expenditures necessary to maintain the usefulness of the association, an unusually large credit balance is at your disposal.

It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence, and the more recent meetings have been remarkable for the greater interest that has been taken in the actual work of the association, and the lesser attention that has been given to the merely social and entertainment features of the programme.

The desire to make the twentieth convention notably a business meeting has so far predominated that we

THE CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT NIAGARA FALLS, N Y., JUNE 8, 9 AND 10, 1897.—SOME OF THE DELEGATES AND VISITORS.

have neither asked nor accepted any favors other than from the electric power companies and several of the manufacturing establishments using electric power for the operation of their works.

Although several delightful and interesting excursions have been arranged for, the association has made, on behalf of its members, a business-like arrangement for the several trips and excursions set forth in the programme of the convention, preferring to pay our way rather than tax the courtesy of the transportation and other companies by accepting "dead-head" privileges. In view of the fact that I have had occasion to communicate with our members from time to time during the past year by the issuance of printed "interim reports" referring to the work undertaken by your executive, it is unnecessary to give an account of my stewardship in this address, but I may say that many matters of urgent importance are pressing for settlement, and these will doubtless receive the most careful attention at your hands during the next few days.

1. Adams-Bagnell Electric Company, Forest City Electrical Company, Gartland Arc Machine Regulator and Bossert Electric Construction Company. 2. H. B. Camp & Co. 3. Partrick & Carter Company and L. A. Chase & Co. 4. Electric Arc Light Company. 5. Westinghouse Electric & Manufacturing Company. 6. Jandus Electric Company. 7. Peru Manufacturing Company and H. W. Johns Manufacturing Company. 8. Belknap Motor Company. 9. Cutter Electric & Manufacturing Company. 10. H. M. Underwood, Diamond Electric Company and Cloos Junction Box.

EXHIBITS AT THE NATIONAL ELECTRIC LIGHT CONVENTION.

The list of papers to be read at this convention is an exceptionally good one, and the authors are of more than continental reputation, and I therefore trust that our members will show their appreciation of the care and study given to the preparation of these papers by being present in force at every session and taking an active part in the discussions that will ensue.

Notwithstanding the progress that has been made in the perfection of apparatus and the application of new principles, there never was a time when there was more to learn than now, and no more fitting occasion is likely to present itself to us to familiarize ourselves with the latest procedure in our chosen profession, and the papers to be read and the discussions thereon will find hundreds of thousands of readers and students, thanks to the electrical journals, of which we are all justly proud.

No other art, science, industry or profession has been so well and faithfully served by an enlightened and progressive technical press as our own, and who can estimate the fair share of credit justly their due for the part they have taken in aiding and advancing the introduction of electromotive force in its many and varied applications?

As we have a lengthy programme before us and several important reports of committees to receive and discuss before we adjourn for mid-day recess, I now declare the twentieth convention of the National Electric Light association opened and ready for the transaction of business.

Committee Reports.

The committee on data proceeded to report through H. M. Swetland, chairman, who read a synopsis of the report, and explained that there was much to contend with in the work. The committee was discharged with thanks to the chairman.

The report of the committee on finance was listened to, it being presented by the chairman, John A. Seely. It showed that the association has no liabilities, with surplus assets amounting to over $2,500. President Nicholls congratulated the members on the showing, and remarked that while he did not see any advantage in an association of this kind accumulating a large fund or a credit balance, he was gratified to think that the association was in such shape that if any opportunity for good work arose to help onward the interests of the active members, the central station members, that the organization had the wherewithal with which to undertake such work.

Capt. William Brophy's report from the committee on rules for safe wiring was presented on Tuesday afternoon, reciting the work of the national conference of electrical, insurance and architectural interests and recommending that the new "standard electrical code" be adopted. In the brief discussion that followed, Capt. Brophy's well known and long-continued efforts in this direction were highly praised, and then the new code was adopted by a unanimous vote.

At the last session of the convention the report of the committee on standard candle power of incandescent lamps was presented by James I. Ayer of Boston, in the absence of Dr. Louis Bell, the chairman. This important subject was discussed at some length; the report was accepted and its recommendations adopted, and the committee was continued.

Place of Next Meeting.

Invitations for the convention of 1898 were received from Omaha, Indianapolis, Old Point Comfort, Va., Montreal, New York and Nashville, Tenn. Prof. R. B. Owens, representing the Trans-Mississippi and International Exposition, spoke for Omaha, and Mr. Evans Woollens addressed the convention in behalf of Indianapolis, speaking particularly for the Commercial Club of that city. All invitations were referred to the executive committee for future action.

Theft of Current and How to Deal with It.

This topic was taken up on Tuesday afternoon and developed an interesting discussion, in which the president, T. C. Martin, Mr. Ayer, Mr. Young, Mr. Stetson, Mr. Barker, Mr. Engel, Mr. Beggs, Mr. Clay and Judge Armstrong took part. Mr. Martin stated that a bill to reach this evil had become a law in Connecticut, and Mr. Young of Waterbury explained its provisions. Messrs. Stetson and Barker spoke of the Massachusetts law. Mr. Engel stated that a bill been introduced in the Legislature of Michigan. Mr. Beggs reported that the law in Ohio was somewhat indefinite, and told of the case of a saloon-keeper who stole current from his company. "It was a saloon in which we never even had furnished the current," said Mr. Beggs. "The man had been cut off for non-payment of bills by one of our competitors. Our lines happened to cross near the rear end of his premises. He threw out a grappling hook and got connection on there and lighted his place for several months in that way. There was really no law in the state of Ohio, unless we prosecuted upon the charge of tapping wires under a law that was passed for the pro-

tection of race-courses and things of that kind. There isn't anything for electric lighting companies."

There was some further discussion, during which Judge Armstrong said:

If we are to do anything in the line of legislation, I think it ought to be in this: to pass bills to prevent frauds upon lighting, water and power companies, say, and let it apply to any person who by any device or contrivance seeks to deprive them of their revenue or interfere with their apparatus, and so on; not by any act of ours recognizing that up to this time it has been no violation of the common law to take current or to take power; that up to this time it has been no offense, and is only an offense now because the Legislature in its wisdom has said so. I am not willing to admit that. I do not think that any of us ought to be willing to admit that. But we can with propriety, if it is thought advisable, recommend legislation to prevent frauds as against these companies, the same as they have to prevent frauds against railroad companies in some places.

After listening to Judge Armstrong's speech, the association on motion empowered the president to appoint a committee of three to draft a uniform bill on this subject, to be passed in the different states requiring such legislation, if possible. Later on the chair appointed James I. Ayer of Boston, Judge Armstrong of Camden, N. J., and Senator Foster W. Voorhees of Elizabeth, N. J.

Papers and Discussions.

J. B. Cahoon's paper on "The Establishment of a Base Price for Current," or "Standardizing Prices for

General Electric Company's Exhibit at the National Electric Light Convention.

Incandescent Light and Power," as it was announced in the convention, was the first to be presented. In the discussion Mr. Beggs advocated the use of uniform blanks in central stations.

The important subject of "Municipal Lighting" was considered in a brief paper read by W. Worth Bean of St. Joseph, Michigan. The discussion was opened by Henry L. Doherty of Madison, Wis., who urged the serious consideration of the subject. Mr. Beggs of Cincinnati followed in the same strain. He said that they all wanted reliable data, and suggested that an expert be employed by the association to secure and compile the figures.

On Wednesday morning J. G. White of New York read a carefully prepared paper on the "Niagara Power Transmission Line." This was a practical and timely paper, and the members evinced their interest by a long discussion.

Next came Arthur Wright's paper on "Profitable Extensions of Electricity Supply Stations." Mr. Wright's home is in Brighton, England, where he is president of a central station company. He was cordially received, and took part in a lively commercial discussion, in which Messrs. Ferguson, Insull, Beggs, Stetson, Fenner, Greene and others participated. This discussion took up all the remaining time of the Wednesday morning session.

The session of Wednesday afternoon was opened by a paper by Prof Charles A. Carus-Wilson of McGill University, Montreal, Canada, the subject being "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

The able paper by Prof. Elihu Thomson of Lynn, Mass., on "Recent Progress in Arc Lighting," came next in order. Prof. Thomson's paper commanded much attention and was pronounced one of the best of the convention. It covered the period since the author's famous essay on "The Electric Arc" at the Providence convention six years ago.

T. C. Martin's paper on "The Daylight Work of Central Stations" was read by Mr. Martin by title only, as it had been printed and distributed among the delegates, and as the session had been quite extended and the delegates were anxious to visit the carborundum works.

On Wednesday evening the convention assembled in the pavilion in Prospect Park, which is a portion of the state reservation, to listen to a paper on "Niagara Power," by L. B. Stillwell, who is the resident electrical engineer of the Cataract Construction company at the Falls. Mr. Stillwell was formerly with the Westinghouse Electric & Manufacturing company, and he had a very great deal to do with the designing of the electrical apparatus in use in the Niagara Falls Power company's station. No man is better qualified to write or talk on "Niagara Power" than is Mr. Stillwell, and for this reason his lecture will not soon be forgotten by those present in Park Pavilion that night. The paper was illustrated by fine stereopticon views, especially pleasing to the ladies, and they all enjoyed it to the utmost, while the delegates agreed that it was one of the really pleasant incidents of the gathering at Niagara.

The entire session of Thursday morning was occupied by B. G. Lamme's paper on "The Polyphase Motor." Mr. Lamme illustrated his remarks and references by 15 diagrams. This was a very technical paper, and demonstrated ability and study.

When the afternoon session opened on Thursday Lieut. F. Jarvis Patten of New York was called on for his paper on "Frequency Transformation." The next and last paper presented was by C. F. Scott of Pittsburg on "Rotaries for Transforming Alternating into Direct Current."

Miscellaneous Business.

The secretary was instructed to draw up suitable resolutions to express the thanks of the association to the outgoing president.

On motion of Mr. Ayer the incoming president was authorized to appoint a committee of three to consult with the Joint Traffic association relative to a readjustment of the freight rates on electrical apparatus.

Before adjournment President Nicholls made feeling reference to the loss that the association had sustained since the last meeting by the death of its active members, Harrison J. Smith of New York and J. M. Orford of Boston.

New Officers.

In executive session the association elected the following-named officers for the ensuing year:

President—Samuel Insull, Chicago.
First Vice-president—A. M. Young, Waterbury, Conn.
Second Vice-president—George R. Stetson, New Bedford, Mass.
Executive Committee—W. Worth Bean, St. Joseph, Mich.; W. McLea Walback, Montreal, Canada; F. A. Gilbert, Boston, Mass.; E. H. Stevens, Elizabeth, N. J.

Points of Interest.

Immediately following the adjournment on Tuesday many of the visitors, including ladies, boarded the trolley cars for a visit to the power house of the Niagara Falls Power company, where they found courteous officials ready to extend them glad welcome. This trip was the first opportunity the ladies had to see anything of the recent developments about the Falls, and it was most heartily enjoyed by all in the party. The great generators were viewed and wondered at, and the work of extension on the wheel-pit and power-house glanced at. The power house is a magnificent building and it was much admired. Admiration and praise was heard on all sides for the Niagara Falls Power company for its beautiful structure.

On Wednesday the carborundum works were visited, and all in the party were greatly interested in the method of using the electrical current there displayed.

An invitation was received from Mr. Littell, vice-president and general manager of the Buffalo Railway company, inviting the delegates to visit the power house of the company on Niagara street, Buffalo.

The scenic attractions of Niagara Falls were enjoyed by the ladies especially. The weather was not altogether favorable, but nevertheless there was much sight-seeing.

Exhibits.

There was no exposition, but many of the associate members and visitors present made more or less elaborate displays in the hotel parlors. Glimpses of a dozen or so of these exhibits are given in the pictures on pages 347, 348 and 349. In the copious "Convention Notes" brief reference is made to all the exhibits.

Members and Visitors.

Following is a list of those in attendance at the Niagara Falls convention:

Ackerman, P. C. ..... New York.
Adams, Thomas E. ..... Cleveland, O.
Adams, Frank P. ..... Stockton, Cal.
Adams, H. C., Jr. ..... Pawtucket, R. I.
Allen, E. H. ..... Chicago.
Allen, H. L. ..... Williamsport, Pa.
Almstead, J. A. ..... Rochester, N. Y.
Andrews, James M. ..... Schenectady, N. Y.
Armstrong, F. C. ..... Toronto, Can.
Armstrong, E. A. ..... Camden, N. J.
Armstrong, Master Wynn ..... Camden, N. J.
Armstrong, Miss Elizabeth W. ..... Camden, N. J.
Arnold, W. L. ..... Chicago.
Austin, T. J. ..... Detroit, Mich.
Badger, T. A., Jr. ..... Quebec, Que.
Baker, C. O. and wife ..... Chicago.
Baker, F. E. ..... New York.
Baker, E. F. ..... Baltimore, Md.
Baker, M. H. ..... Boston, Mass.
Balida, W. C. ..... Utica, N. Y.
Barker, F. E. ..... Boston, Mass.
Barnes, C. R. ..... Rochester, N. Y.
Barrett, W. J. ..... Los Angeles, Cal.
Barstow, W. S. ..... Brooklyn, N. Y.
Boss, John E. ..... Elkhart, Ind.
Bean, W. Worth ..... St. Joseph, Mich.
Beggs, John I. ..... Cincinnati, O.
Bell, E. F. ..... Youngstown, O.
Belote, Jas. L. ..... Norfolk, Va.
Benedict, H. W. ..... New York.
Bennie, J. McN. ..... Pittsburg, Pa.
Bernard, E. G. ..... Troy, N. Y.
Biggar, E. B. ..... Toronto, Can.
Blake, S. N. ..... Elmira, N. Y.
Bowman, Fred. A. ..... New Glasgow, N. S.
Bradley, Jas. ..... Boston, Mass.
Bradley, J. M. ..... Birmingham, Ala.
Brady, Paul T. ..... Syracuse, N. Y.
Brady, T. H. ..... New Britain, Conn.
Bragg, C. A. ..... Philadelphia, Pa.
Brayton, M. J. ..... Utica, N. Y.
Brooks, H. H. ..... Boston, Mass.
Brophy, Wm. ..... Boston, Mass.
Bryant, W. C. ..... Bridgeport, Conn.
Burns, Chas. F. ..... Rochester, N. Y.
Bush, A. R. ..... Boston, Mass.
Calisch, J. C. ..... Pittsburg, Pa.
Candee, Willard L. ..... New York.
Canfield, M. C. ..... Cleveland, O.
Carrier, A. E. ..... Jeannette, Pa.
Carroll, John ..... Montreal, Can.
Carus-Wilson, Chas. A. and brother ..... Montreal, Can.
Carus-Wilson, Ernest ..... Montreal, Can.
Cary, E. E. ..... St. Catherines, Ont.
Chamberlain, Wm. W. ..... Norfolk, Va.
Chase, Samuel A. ..... New York.
Claflin, Geo. E. ..... Providence, R. I.
Clay, Henry and wife ..... Philadelphia, Pa.
Clay, Savilla E. ..... Philadelphia, Pa.
Clay, Mabel ..... Philadelphia, Pa.
Clements, A. B. ..... New York.
Coles, Stephen L. ..... New York.
Conklin, L. H. ..... Brooklyn, N. Y.
Cooper, W. H. ..... Oil City, Pa.
Cooper, Thos. ..... Pittsburg, Pa.
Copeland, F. A. ..... La Crosse, Wis.
Corey, R. B. ..... New York.
Coster, Maurice ..... Chicago.
Covington, F. D. ..... Peru, Ind.
Cox, Geo. E. ..... Niagara Falls, N. Y.
Crane, W. F. D. ..... New York.
Crider, J. S. ..... Pittsburg, Pa.
Crouse, H. B. ..... Syracuse, N. Y.
Cummings, Jas. F. ..... Pittsburg, Pa.
Cushing, J. O. ..... Buffalo, N. Y.
Cutter, Henry B. and wife ..... Philadelphia, Pa.
Cutter, George ..... Chicago.
Daniels, A. L. ..... Anltman, O.
Davenport, Geo. W. ..... Boston, Mass.
Davis, Chas. B. and wife ..... Boston, Mass.
Davis, D. L. ..... Salem, O.
Dee, Jas. R. ..... Houghton, Mich.
Dee, A. V. ..... Philadelphia, Pa.

DeLand, Fred.....Chicago.
Deviae, Joseph P.....Niagara Falls, N. Y.
Dickey, D. D.....Pittsburg, Pa.
Dickinson, A. F.....Geneva, O.
Dixon, T. W.....Colmnbus, O.
Doan, J. P.....Jacksonville, Ill.
Donds, H. J.....Cleveland, O.
Douglass, Miss H.....Allentown, Pa.
Douglass, Stephen A.....New York.
Drake, John I.....Providence, R. I.
Dunlap, Orrin E.....Niagara Falls, N. Y.
Dunlap, W. K.....Pittsburg, Pa.
Durlaad, D. C.....New York.

Eaton, L. W.....Bridgeport, Conn.
Elliott, W. S.....Pittsburg, Pa.
Ely, W. Caryl.....Niagara Falls, N. Y.
Emerick, L. W.....Syracuse, N. Y.
Engel, W. P.....Charlotte, Mich.
Estabrook, C. E.....New York.
Eyre, M. K.....New York.

Fairbanks, H. H.....Worcester, Mass.
Fenner, M. M.....Fredonia, N. Y.
Ferguson, L. A.....Chicagn.
Fesseadea, Robert.....Providence, R. I.
Forbes, Geo.....Olean, N. Y.
Foster, R. C. and wife.....Cleveland, O.
Freeman, E. T.....Halifax, N. S.
Frewyear, T. C.....Buffalo, N. Y.

Gaffney, John J.....Newark, N. J.
Garrison, A. C.....St. Louis, Mo.
Gaskill, Jos. H. and wife.....Mount Holly, N. J.
Gates, J. Holt.....Chicago.
Gillett, E. K.....Cincinnati, O.
Glidden, Herbert P.....Cleveland, O.
Goddard, Stephen H.....New York.
Godfrey, J. W.....New York.
Gorke, H. J. and wife.....Syracuse, N. Y.
Graham, J. P.....Altoona, Pa.
Greene, M. B.....Schenectady, N. Y.
Greene, S. Dana.....Schenectady, N. Y.
Greene, L. W.....Brooklyn, Mich.

EXHIBITS OF THE WESTERN ELECTRIC COMPANY AND THE AUTOMATIC CIRCUIT BREAKER COMPANY AT THE NATIONAL ELECTRIC LIGHT CONVENTION.

Greene, B. E.....New York.
Grier, Thos. G.....Chicago.
Grier, Edw. R.....Chicago.
Gwynn, E. F.....Ben Avon, O.

Habirshaw, Dr.....New York.
Hale, R. S.....Boston, Mass.
Hall, Andrew F.....Southbridge, Mass.
Hamill, S. M.....Cleveland, O.
Hammer, Wm. J.....New York.
Hanley, G. W.....Marinette, Mich.
Harrington, F. W.....New York.
Harrington, Walter E.....Camden, N. J.
Harding, W. H.....Baltimore, Md.
Harper, T. J.....Atlanta, Ga.
Harting, Wm. J.....Detroit, Mich.
Harvey, A. W.....New York.
Haskins, Caryl D.....Boston, Mass.
Hastings, Hon. Arthur C.....Mayor Niagara Falls.
Hays, Henry and wife.....Newark, N. J.
Heinrichs, Ernest H. and wife.....Pittsburg, Pa.
Henderson, Alex.....New York.
Herrick, Albert B.....New York.
Hills, Chas. I.....New York.
Hoag, Geo. M.....Cleveland, N. Y.
Holman, G. W. G.....Philadelphia, Pa.
Holmes, B. P.....Youngstown, O.
Hoover, P. H.....New York.
Horsfield, Ralph.....Chapel-en-le-Frith, Eng.
Howard, F. S.....Chicago.
Hubbell, J. B.....Bridgeport, Conn.
Hughes, T. E.....New York.
Humphrey, C. B.....Pittsburg, Pa.
Hurd, G. P.....Monroe, Mich.
Hurlbut, Samuel.....Norwich, Conn.
Hybre, H. C.....Los Angeles, Cal.

Insull, Samuel.....Chicago.
Isaacs, M. J. and wife.....Chicago.

Jagoe, H. B. and wife.....New York.
Jennings, John J.....Wilkinsburg, Pa.
Johns, S. H. D. and wife.....Cleveland, O.
Johnson, E. O.....Boston, Mass.
Johnson, W. A.....Toronto, Can.
Johnston, W. J. and wife.....New York.
Johnston, Franklin A.....New York.
Jones, A. H.....Philadelphia, Pa.
Jones, A. J.....New Brunswick, N. J.
Jones, H. Whitford.....Cleveland, O.
Juneman, C. H.....Chillicothe, O.

Keck, T. P.....Savannah, Ga.
Kelsch, R. S.....Montreal, Can.
Kieley, T.....New York.
Kimball, Fred. M.....Boston, Mass.
Kimball, A. H.....Fitchburg, Mass.
Kirkland, J. W.....Schenectady, N. Y.
Kreidler, W. A. and wife.....Chicago.

Lamme, Benj. G.....Pittsburg, Pa.
Lane, G. A.....Oneonta, N. Y.
Langdon, John.....Toronto, Can.
Laughlin, F. M.....Pittsburg, Pa.
Lawrence, W. H.....Cleveland, O.
Lean, Geo. R.....Cleveland, O.
Le Blond, Frank.....Niagara Falls, Ont.
Leslie, E. A.....New York.
Lieb, J. W., Jr.....New York.
Livingston, M. L.....Peabody, Mass.
Lloyd, Herbert.....Philadelphia, Pa.
Lott, Frank G.....Niagara Falls, N. Y.
Lott, J. C.....New York.
Lovejoy, J. R. and wife.....Schenectady, N. Y.
Low, W. W.....Chicago.
Low, D. W.....Wellsville, O.
Lucas, R. E.....Jonesboro, Ind.
Lundell, W. H.....Baltimore, Md.
Lüpke, Paul.....Trentoa, N. J.
Lyman, H. M.....Canton, O.
Lynch, A. H.....Morristown, N. J.

McCabe, E. F.....Chatham, N. Y.
McCormack, E. D.....Toronto, Can.
McCullough, W.....New York.
McDonald, W. B.....Chicago.
McKinlock, Geo. A.....Chicago.
McLeod, Thos. I.....New York.
McNamee, F. W.....Wabash, Ind.
McQuaide, Jas. P.....New York.
MacConnell, M. J.....Cleveland, O.
Macintire, Geo. R.....New York.
Madgen, Wm. L.....London, Eng.
Mann, Geo. E.....Woodville, N. H.
Manson, Geo. T.....New York.
Marks, L. B.....New York.
Martin, K. G.....New York.
Martin, T. C.....New York.
Mason, J. H.....Boston, Mass.
Mason, Miss Mae E.....Boston, Mass.
Mason, L. T.....Hornellsville, N. Y.
Medbery, Chas. F.....Chicago.
Mercein, Thos. R.....Milwaukee, Wis.
Meyer, Henry J.....Dolgeville, N. Y.
Miller, A. M.....Red Oak, Ia.
Miller, John H.....Springfield, O.
Moore, W. E.....Augnsta, Ga.
Moore, H. P.....Boston, Mass.
Morgan, Miss Carrie W.....Camden, N. J.
Morris, Elmer P.....New York.
Morton, Charles.....Montreal, Can.
Mumper, J. W.....Hanover, Pa.
Murphy, John.....Ottawa, Can.
Murphy, James.....Renovo, Pa.
Mustard, John.....Philadelphia, Pa.
Mustard, A. H.....New York.

Nash, E. L.....Philadelphia, Pa.
Nathan, Marcus.....New York.
Newell, D. E.....New York.
Newton, A. D.....Hartford, Conn.
Nicholls, Frederic.....Toronto, Can.
Noecker, F. M.....Renovo, Pa.

Osborne, W. F.....New York.

Packard, W. D.....Warren, O.
Packard, Miss Carlotta.....Warren, O.
Page, A. D.....Newark, N. J.
Paine, Sidney B.....Boston, Mass.
Patten, F. Jarvis.....New York.
Peabody, D. W.....Fenton, Mich.
Pease, A. H.....Hartford, Conn.
Peck, E. H.....New York.
Peeples, Geo. L.....Philadelphia, Pa.
Perry, J. W.....Philadelphia, Pa.
Perry, C. C.....Indianapolis, Ind.
Perry, F. L.....Chicago.
Phillips, E. F.....Detroit, Mich.
Phillips, W.....Niagara Falls, N. Y.
Pierce, Henry A.....Pawtucket, R. I.
Porter, Geo. F.....New York.
Powell, Geo. A.....St. Catherines, Ont.
Powell, Miss Lena.....St. Catherines, Ont.
Prentiss, I. R.....Cleveland, O.
Price, Chas. R.....Boston, Mass.
Price, Chas. R.....New Bedford, Mass.
Price, Chas. W.....New York.
Price, E. F.....Niagara Falls, N. Y.
Purinton, A. J.....Waterbury, Conn.
Pyle, Jas. E.....West Chester, Pa.

Radford, J. A.....Chicago.
Reason, Henry.....Brighton, Eng.
Redman, Geo. A. and wife.....Rochester, N. Y.
Reeves, J. W.....Johnstown, Pa.
Regan, W. D. A.....Lynn, Mass.
Reid, Thorburn.....New York.
Renek, Howard.....Easton, Pa.
Rice, John.....Cleveland, O.
Richardson, Frank.....North Adams, Mass.
Ritzen, W. W.....Jersey City, N. J.
Roberts, W. H.....Brockport, N. Y.
Roberts, C. P.....Brockport, N. Y.
Rockafellow, E. W.....New York.
Rockwood, G. O.....Indianapolis, Ind.
Roehl, C. E.....St. Joseph, Mo.
Rogers, W. S.....Cleveland, O.
Ross, C. A.....Chicago.
Rothsay, J. F.....Niagara Falls, Ont.

Sandt, Geo.....Atlanta, Ga.
Schaffer, Louis.....Antwerp, Belgium.
Scheeffer, G. A.....Peoria, Ill.
Schoellkopf, A.....Niagara Falls, N. Y.
Schutt, D. A.....Peru, Ind.
Schwattmann, Ferd.....St. Louis, Mo.
Scott, Chas. E.....Bristol, Pa.
Scott, Chas. F.....Pittsburg, Pa.
Sewell, John E.....Waterbury, Conn.
Shaw, A. C.....New York.
Shuriat, Emil J.....Sandusky, O.
Skiuner, C. E.....Pittsburg, Pa.
Smaill, A. E.....Montreal, Can.
Smith, T. Carpenter.....Philadelphia, Pa.
Smith, Orin, Jr.....Pawtucket, R. I.
Smith, Ralph D.....Westboro, Mass.
Smith, W. S.....Toledo, O.
Smith, F. Ellwood.....W. Somerville, Mass.
Smith, Thos. B. and wife.....Waltham, Mass.
Smith, F. D.....Pittsburg, Pa.
Smith, J. Brodie.....Manchester, N. H.
Solomon, John I.....New York.
Sparrow, E. S.....W. Somerville, Mass.
Spear, A. D.....Cleveland, O.
Sqnier, George O.....Fortress Monroe, Va.
Stetson, George R.....New Bedford, Conn.
Stevens, E. H.....Elizabeth, N. J.
Stevens, J. F.....Philadelphia, Pa.
Stieringer, Luther.....New York.
Straus, Herman.....New York.
Struck, J. H. A.....New York.
Sturges, G. G.....Scranton, Pa.
Swain, R. A.....Chicago.
Swan, G. W.....New York.

Thomson, Elihu.....Lynn, Mass.
Thresher, A. A.....Dayton, O.
Tolles, C. L.....Hartford, Conn.
Torbert, Horace.....Dubnque, Ia.
Townsend, Thomas L.....Philadelphia, Pa.
Tratman, E. E. Russell.....New York.
Tremaine, H. A.....Fostoria, O.
Tulloch, Seymour W.....Washington, D. C.
Tuttle, W. E.....Niagara Falls, N. Y.

Upton, F. R.....New York.
Urquhart, D. F.....Boston, Mass.

Vail, J. H.....Philadelphia, Pa.
Van Rauss, S. B.....Syracuse, N. Y.
Von Phul, Wm.....New Orleans, La.
Voorhees, Foster M.....Elizabeth, N. J.

Walbank, W. M. Lea.....Montreal, Can.
Watts, Geo. W.....Toronto, Can.
Webster, N. D.....New York.
Wetzler, Jos. and wife.....New York.
Wheeler, S. M.....LeRoy, N. Y.
Whipple, Bailey.....Cleveland, O.
Whitall, Miss Mary.....Woodbury, N. J.
White, J. G.....New York.
White, C. P.....Evansville, Ind.
Whitehead, John B., Jr.....Norfolk, Va.
Wieman, Wm. P.....Washington, Pa.
Wilcox, N. T.....Seneca Falls, N. Y.
Wiley, Geo. L.....New York.
Wilkins, Edward.....Philadelphia, Pa.
Wilkinson, C. D.....Chicago.
Williams, J. P.....New York.
Williams, Arthur.....New York.
Willis, Chas.....Pontiac, Mich.
Wilson, Wm.....Milwaukee, Wis.
Wirt, H. C.....Schenectady, N. Y.
Wise, Stuart W.....New York.
Woodward, Wm. C.....Providence, R. I.
Woollens, Evans.....Indianapolis, Ind.
Wright, Arthur.....Brighton, Eng.
Wyant, Robert E.....Derby, Conn.

Young, A. M.....Waterbury, Conn.
Young, John.....Chicago.

Convention Notes.

W. J. Hammer, the well-known electrician of New York, was a visitor.

H. J. Gorke, accompanied by Mrs. Gorke, did the honors for Syracuse, N. Y.

Capt. William Brophy, the courteous and ever welcome electrician of the city of Boston, was in Niagara

MITCHELL TEMPERED COPPER COMPANY'S EXHIBIT AT THE NATIONAL ELECTRIC LIGHT CONVENTION.

during the entire period of the convention. Capt. Brophy is a man of many friends.

The Forest City Electric company of Cleveland, O., was represented by G. A. Thomson.

W. H. Harding, one of the old-timers, appeared at Niagara and met with a warm welcome.

Of course A. A. Thresher of the Thresher Electrical company managed to drop in from Dayton, O.

W. L. Arnold of Chicago came too, but it was a matter of regret that his brother, B. J. Arnold, could not spare the time.

The Solar Carbon company of Pittsburg, Pa., was represented in the person of Secretary and Treasurer F. N. Laughlin.

Secretary and Treasurer J. S. Crider and P. McNiven Bennie, assistant superintendent and treasurer, represented the Washington Carbon company.

H. P. Moore of the Shawmut Fuse Wire company of Boston represented that concern, and showed a number of switches, which attracted no little attention.

Stephen A. Douglass of New York was seen in Buffalo, and it is rumored that he spent several hours in a quiet way with a select coterie of delegates from the metropolis.

S. M. Wheeler was in attendance securing expert witnesses in the condemnation proceedings for the Le Roy (N. Y.) gas and electric plant which is to be purchased by the town.

H. McKenzie of the International Hotel cafe showed a very creditable spirit of hospitality, and the liberal manner in which he dispensed the courtesies of the hotel made it many friends.

James Bradley of the Bernstein Electric company of Boston did not bring any samples of incandescent lamps to the convention, as he came with but little preparation. However, the product is so widely known that it would not have been necessary.

[*Continued on page 353.*]

Western Electrician.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—**the only general electrical paper published in the West**—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be furnished on application.

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EXPRESSIONS of gratification and approval were heard on all sides when the special 100-page convention number of the WESTERN ELECTRICIAN was received by delegates and visitors at the Niagara Falls meeting of the National Electric Light association, and congratulations were bestowed unsparingly upon those who represented the paper at that gathering for the remarkable showing that had been made. It was generally conceded that that issue of the WESTERN ELECTRICIAN exceeded by far all former efforts in the way of convention numbers and created a new standard for electrical publications.

The appreciation shown by the trade, as evinced in the advertising patronage of this journal, made a good impression upon the delegates and visitors and was the subject of much discussion. It was soon apparent, and was indeed admitted on all sides, that the WESTERN ELECTRICIAN had captured the convention, and its friends and patrons naturally shared in its good fortune.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

IN these days of conventions and meetings of one kind and another we must not lose sight of the fact that a young and vigorous organization, representing the electrical interests of one of the most important sections of the country, will hold a mid-summer meeting shortly in this locality. The date for the convention of the Northwestern Electrical association at La Crosse, Wis., is July 21st, and the gentlemen having in charge the arrangements for the meeting and the preparation of the programme promise that the reputation of the organization will not suffer if their plans are faithfully executed. The association has been particularly fortunate during the last few months in defeating the plans of municipal ownership schemers, and on the whole the members have reason to congratulate themselves.

PRESIDENT NICHOLLS, in his annual address at the Niagara Falls convention, made a graceful reference to the value to the electrical industry of the services of the technical press. It is true—and the statement may be made without embarrassment or undue pride—that the electrical interests are well served by their journals, and it is pleasant that the fact should be thus prominently and publicly acknowledged. But it is equally true that the electrical press speaks for an exceptionally intelligent, alert and progressive constituency, which demands that its journalism shall be creditable to it. The electrical journals are fairly representative, and are, of course, very largely the product of the modern industry which they exploit, although it is hoped that they are not mere servile dependents, but have opposed extravagances and have stood for enduring things of good report.

THE most important development in the street railway field of late was the action of the Illinois Legislature in passing and Governor Tanner in approving the Allen bill, which was intended to relieve the street railway corporations of Chicago. The principal provisions of this measure are those which extend existing franchises 20 years and give the City Council authority to further extend their life to 50 years, and insures the five-cent fare. The Allen bill contained no such provision as the Humphrey bill, requiring the corporations to pay large sums of money into the city treasury in consideration of these extensions and privileges. The measure also effectively shuts out opposition companies from using the tracks of existing corporations. Permission is granted existing companies to combine within a certain period and enjoy the benefits of the bill. It is on the whole a very favorable measure and places the street railway securities of Chicago upon a firm basis for 20 years.

IN direct opposition to the decision of the United States Circuit Court, the Supreme Court of Indiana on June 11th decided that the three-cent street-car fare law passed by the last Legislature for the benefit of Indianapolis was constitutional. In the Federal Court recently the same law was declared unconstitutional and injunctions were granted by Judge Showalter against its enforcement. The state will insist on three-cent fares unless the street car company secures an injunction pending appeal to the Supreme Court of the United States. In the Hammond cases recently, where the state Supreme Court and the United States Circuit Court differed, the Supreme Court of the United States held that it was not its policy to enter into conflict with the Supreme Courts of states. On this Attorney-general Ketcham thinks the three-cent fare law will stand, but that five-cent fares will be collected until Judge Showalter modifies his order, which he will doubtless do.

THERE can be no doubt that the National Electric Light association acted wisely in selecting Samuel Insull president for the ensuing year. Mr. Insull posseses personal qualifications of a high order for the position, and his selection will, it is believed, have the effect of harmonizing many elements that have heretofore acted independently, if indeed they have not been in direct and open conflict. It will assure the support and co-operation of the Edison central station men throughout the country on a scale hitherto unknown in the history of the organization, and it will satisfy the electrical interests of Chicago and the West that they are not being neglected by the National association. A decision on the part of the executive committee to hold the next meeting in the West will confirm the good impression which the Niagara convention created when it made its selection of a presiding officer. The WESTERN ELECTRICIAN sincerely trusts that the executive committee will not allow this excellent opportunity to strengthen and solidify the movement by determining to hold the next meeting in the West to pass.

UNLESS public opinion dissuades the American Bell Telephone company from entering upon a crusade against users of telephones manufactured by independent companies, it is feared that that corporation will soon begin infringement suits in all parts of the country under the Berliner patent. Such a policy can only be construed as a determination on the part of that powerful corporation to annoy and intimidate those who are patronizing anti-Bell interests, rather than a desire to enforce its legal rights. It has been pointed out that if the Bell company desires to establish its rights by proceeding against users of independent telephone apparatus rather than makers of such instruments, it should make a test case against the United States government, which has been using a system of this kind in the Interior Department at Washington. This would relieve the Bell company of the imputation of instituting proceedings for the purpose of annoying and intimidating patrons of rival concerns, and it would furnish an admirable opportunity to settle the question upon its merits. Telephone men are unanimous in the opinion that the Bell company decided upon this plan of warfare as the most likely one to check the growth of the independent telephone movement, and as the one which would prove the most serious drain upon the resources of its competitors. There is no doubt that it has been urged by local exchanges to take some vigorous steps to defend the Bell interests against the encroachments of outside companies. The heavy royalties exacted by the parent company from exchanges make it impossible for the latter to compete successfully in the matter of price with the independent companies, and as the futility of the plan of giving free telephone service has been demonstrated, the scheme of harrassing subscribers of anti-Bell companies was doubtless adopted as the only measure left that would not bring the issue squarely between the manufacturers.

The Bell company might take a lesson from the history of the incandescent lamp litigation. At the present time any movement having a tendency to create a monopoly will suffer because of popular prejudice, and when such a movement is directed by a corporation like the Bell company, with its record on the Berliner patent fresh in the public mind, it cannot be expected that much consideration will be shown. The incandescent lamp litigation failed, although the General Electric company's position was far stronger than that of the American Bell Telephone company. The latter corporation, with all its wealth and influence, will find that the plan of creating a monopoly in the telephone field will meet determined and united opposition on the part of the American people.

Design and Construction of Electric Power Plants.

By Bion J. Arnold, M. S.

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Part VIII.—*Continued.*

Generators and Switchboard.

Switchboard.—The switchboard is the connecting link between the generators and the distribution system. It contains the devices for regulating the output of the generators, the instruments for measuring the current and the switches by means of which the different dynamos are connected to the various circuits. Its arrangement should be most carefully studied, for flexibility is as important here as in any other part of the station, and changes in the combinations of the dynamos and circuits should be possible without the slightest interruption of service.

The location of the board should be in plain sight of

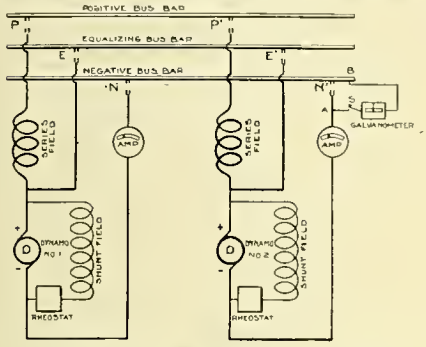


FIG. 42. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM OF SWITCHBOARD CONNECTIONS SHOWING EQUALIZER BAR AND CUTTING-IN GALVANOMETER.

one standing by the generators and in a place easily accessible from the dynamo floor. In stations having a number of dynamos and a large number of outgoing circuits, where a switchboard operator is required in constant attendance, it is allowable, and indeed advisable, to erect the board upon a gallery overlooking the dynamos and engines. This makes a convenient and handsome arrangement, but for stations where the dynamo attendant also manipulates the switches it will be an inconvenient one. In such a case the distance between the generators and the board should be the shortest possible in order that the switches may be quickly reached in case of emergency. For small stations it will generally be found best to place the board along the wall and near the dynamos. It should be set out from the wall from two and one-half to four feet to allow easy access to the back connections.

Each generator in the plant will have at least two leads to the switchboard and probably more. These may be placed beneath the floor or run overhead. The first method has the advantage of much the neater appearence, while the second method facilitates inspection and costs less. In large stations having a traveling crane overhead wires are impracticable, but in such a case a convenient basement under the dynamo room floor usually allows the conductors to be carried along its ceiling upon insulators. Perfect insulation, easy inspection and protection from accidental injury should be aimed at in locating the dynamos leads.

Easy manipulation is generally secured by connecting

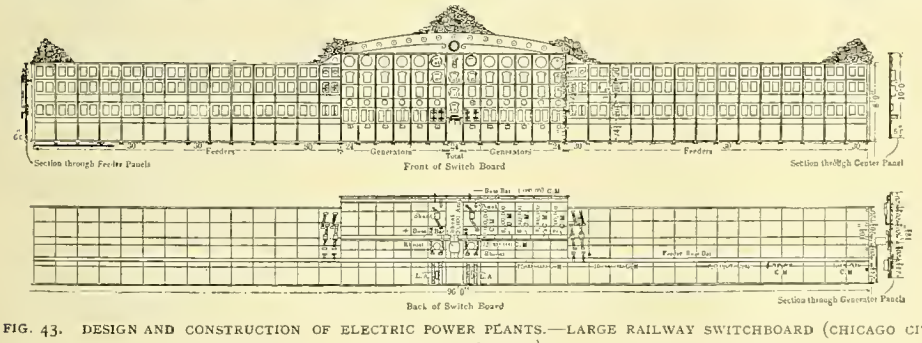


FIG. 43. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LARGE RAILWAY SWITCHBOARD (CHICAGO CITY RAILWAY COMPANY).

the leads from the machines through switches to omnibus bars, generally known as "bus bars," from which the various circuits can be easily taken. In case it is desired to divide the load between two or more generators some additional provision must generally be made. The most ordinary case that occurs in the modern power plant is that which calls for the operation of two or more direct current compound-wound generators in parallel. To do this successfully it is necessary to provide an "equalizer," the connections to which are shown in the diagram (Fig. 42).

Here the connections to the positive and negative bus bars are made as usual through the switches $P\,P'$ and $N\,N'$, but additional connections are also made from between the positive brushes and the series fields to an equalizing bus-bar through the switches $E\,E'$, as shown. Now suppose dynamo No. 1 to be carrying such a large load that it is necessary to throw in dynamo No. 2, so that the load will be divided between the two machines. It is to be understood that switches P, E and N are closed. Dynamo No. 2 is brought up to speed, when it will excite itself by means of the shunt fields. The switches P' and E' are then closed. The series windings of the two generators are then in parallel, and dynamo No. 2 will immediately come up to full voltage. By means of the rheostat in the shunt field the voltage of generator No. 2 can be regulated until it becomes the same as that of the bus bars, when switch N' can be closed, and the two generators, working under the same conditions, will divide the load, and it will be impossible for one generator to run the other as a motor. This is due to the fact that as soon as the electromotive force of either generator falls off, due to a decrease in speed from any cause, the current through the series field of the other dynamo divides and part of it passes through the series winding of the slow machine, tending to strengthen its field and thus raise its electromotive force. If the equalizing connections were not provided it would be possible, by one machine decreasing in voltage, to not only throw the entire external load upon the other machine, but also for it to add itself as a motor load to the system. If the effect of the series coils overcomes that of the shunt windings, the dynamo will change the direction of its rotation when running as a motor, and the consequences may be serious.

It is important that the equalizing connections contain very little resistance, and therefore if the switchboard is situated some distance from the generators the necessary connections can be made at the generators themselves. An auxiliary switchboard containing the equalizing switches is sometimes placed near the dynamos and in plain view from the main board.

In order to ascertain when the dynamo that is to be thrown in is at the bus-bar voltage its pressure is some times measured by a voltmeter; sometimes a comparison is made between the brilliancy of its pilot lamp and that of another lamp connected in circuit, but the best way is by means of a cutting-in galvanometer. The connections of such a device are shown in Fig. 42. One terminal is connected to the negative bus bar and the other to the negative lead from the dynamo. If the voltage at each terminal is the same, the galvanometer needle stands at zero and switch N' can be closed, but in case the bus bar and generator are at different potentials a current will flow and the corresponding deflection will indicate whether the dynamo pressure is to be raised or lowered. It will be noticed that the amperemeter is placed in the leg of the circuit through which all the current of the machine must necessarily pass. By a comparison of the indications of the ammeters of both machines it can be easily seen whether or not the dynamos are dividing the work according to their capacity.

The bus bars upon a switchboard are usually mounted upon the back of the board and are composed of hard drawn copper and are built up of separate bars so as to provide ventilation and easy connection to the terminal lugs of the switches and cables as well as an easy method for increasing the current-carrying capacity of the board. At least one square inch cross-section should be allowed for every possible thousand amperes of current.

The material of the switchboard itself is usually either slate or marble. Wood should be used only for temporary installations, and then the switches should be mounted upon separate insulating bases. Both marble and slate present a handsome appearance, and this is especially true of the latter when marbleized and highly polished. In selecting the slate or marble care should be taken to be sure that they contain no conducting veins, as the impurities in the board may cause a troublesome ground or short-circuit. As marble and slate come in small pieces, it is necessary to build the board up of panels. This, as a rule, is accomplished by securing the parts to a framework of angle iron. The panel construction renders it easy to make additions to the board without spoiling its appearance, as the arrangement of the instruments and switches upon the panels may be made standard. In constructing the iron framework it should be arranged so as not to interfere in any way with the electrical conductors.

The switches upon the board should be composed entirely of hard drawn copper, and no cast parts should be allowed. The conductivity of cast metal is considerably less than that of hard drawn copper, and one fault with many switches is that the makers allow too small an amount of metal in the bases and terminals. Even with hard drawn copper at least one square inch of cross-sectional area should be provided for every 60 amperes maximum possible load in the clips and for every 100 amperes in the terminal and bolted surfaces. For most purposes what is known as a knife switch is far preferable over any other type. In this style of switch the blade enters between two copper springs or clips, which should make good contact with the blade and be arranged so that they adjust themselves. For large currents switches are built up of a number of blades. Switches are not intended to break a large current; every well designed board contains some form of circuit breaker for this purpose in case of emergency. The switch should be arranged so that it breaks along the entire length of its contact surface at the same time, to avoid an arc at any one point. All single-throw switches should be arranged so as to throw upward, which will make it impossible for the blades to accidentally fall closed.

The circuits breakers mentioned are usually electromagnetic devices designed to automatically break the circuit in case the current rises above a certain determined amount. These circuit breakers act upon the principle of a solenoid and can be set to break at any current. They are positive and quick in their action, can be quickly closed and can be held closed in case it is desired to burn out a ground. They do not scatter fused metal in all directions, and in every other way are far preferable to the old practice of inserting fuses in the circuits. At the present time the tendency is to adopt them universally for switchboard work.

Coming now to measuring instruments, it may be noted that each generator will have its corresponding ammeter, as already shown, and it will also be well to supply an ammeter to each feeder circuit if possible. The most convenient switchboard instrument for measuring current is the shunt ammeter, with which it is un-

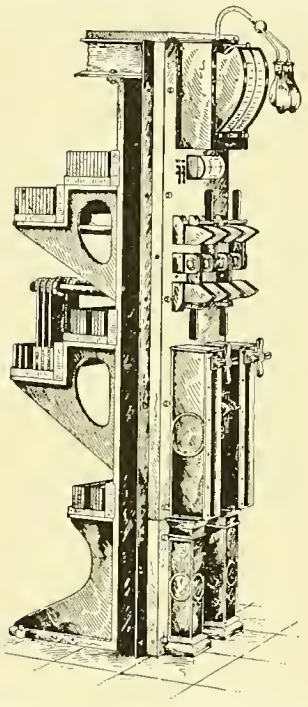


FIG. 44. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—SWITCHBOARD PANEL OF CENTRAL STATION LIGHTING PLANT (CHICAGO EDISON COMPANY).

necessary to run the current through the meter itself. With this instrument it is only required to insert a standard resistance in any convenient part of the circuit, connecting the terminals by voltmeter leads to the instrument, which is really a milli-voltmeter calibrated to read amperes. For power station work the D'Arsonval type of galvanometer must be used, as it is not affected by external magnetic disturbances. The switchboard ammeters should be accurate over their entire scale, should have uniform scale divisions and should be unaffected by changes of temperature.

Electrostatic voltmeters are now being developed on a commercial basis and promise to become useful switchboard instruments. They have the advantage of being cheap, simple in action and are applicable to either direct or alternating currents; they are undisturbed by outside magnetic influences and consume no energy whatever.

Voltmeters similar in pattern to the ammeter should be placed upon the board, but it will hardly be necessary to provide so many. By means of a suitable switch, one instrument may be connected to a great many circuits, but as a rule it is well to have one voltmeter for each generator at least. Recording voltmeters are often used to obtain a continuous record of the voltage and are especially useful in furnishing a check upon the attendants, as they indicate whether the voltage has been allowed to drop below a certain amount at any time.

A log of the readings of the ammeters, taken at regular intervals, is often kept by the switchboard attendant, but where this is inconvenient recording wattmeters are placed in the circuits. These instruments integrate the amount of power passing through the circuit in any given time and may be obtained sufficiently accurate for most power station purposes. Their use upon a constantly fluctuating load, as that of an electric railway or of elevator service, is, however, up to the present, a matter of doubt. The trouble is that the instruments are not accurate through their entire range. To get

the watt-hours it is necessary to multiply the readings by a constant. If calibrated at any given load this constant may be obtained, but unfortunately it will generally be found to vary with different loads, being larger the smaller the load. If the difference in the constant is found to be considerable, it becomes a matter of some doubt what constant to use on a varying load, as exact calibration is practically difficult. The best that can be said of wattmeters at present is that the readings on variable loads can hardly be relied upon as being correct within 10 per cent., but very often it will be a valuable matter of information to know the power produced even within this limit, and wattmeters are almost universally used in power stations. Recording wattmeters may be obtained for direct current, for alternating current and for arc lighting circuits.

It is important that all electric circuits leaving the station be provided by one of the standard forms of lightning arresters, which will protect the generator by diverting the lightning discharge, causing it to pass harmlessly into the ground. The arrester is usually placed back of the board and connected between the outgoing circuits and the ground. The ground connection should receive especial attention, and no pains should be spared to insure a permanent ground in damp soil. A very good plan is to make an auxiliary connection to a system of water pipes or to metallic plates buried deep in the ground.

For railway work the switchboards have become very nearly standard. Each generator is furnished with a panel containing the positive and negative main switches, the field rheostat for controlling the generator voltage, an overload switch or main circuit breaker, a shunt ammeter and a recording wattmeter. The switchboard is built up of as many panels as the station contains generators, and an additional panel may be provided to contain an ammeter for indicating the total ampere output of the station as well as at least two voltmeters. If the voltmeters are arranged either upon an auxiliary board or upon swinging frames, so as to be visible from any portion of the board, it will facilitate the manipulation when throwing in additional generators.

The trolley line of the road will be divided up into sections, each section being supplied with current by a separate feeder from the power house. These feeders will leave the switchboard from special panels, good practice being to allow two feeders to each panel. As the return circuits come to the board through a common negative lead, but one quick-break switch will be necessary to control each outgoing circuit. The remainder of the equipment for each feeder consists of a circuit breaker, a shunt ammeter and a lightning arrester. All the instruments but the lightning arresters and rheostats will be mounted upon the front of the board, the ammeters at the top and the switches lower down but within easy reach.

The large switchboard used to control the output of 12 generators over 56 feeders from the Forty-ninth street plant of the Chicago City Railway company is shown in Fig. 43 (p. 351). It may be instructive to follow the circuits. The lead from each generator passes up from below through a main switch to a common positive bus bar, thence through the large shunt for the ammeter, which is to indicate the total output of 20,000 amperes, to the main feeder bus bar. Each feeder passing out to the line takes current from this bar through a switch, an ammeter shunt and a circuit breaker. The returning circuits are led to a common negative bus bar shown at the top of the board, from which the current for each generator passes through a wattmeter, an ammeter shunt, a circuit breaker, a main switch and thence to the dynamo.

Fig. 44 shows the detail of a compact generator panel from the switchboard of the Harrison street plant of the Chicago Edison company. This panel accommodates the two generators usual with the three-wire system. It is provided with two sets of bus bars, one set for a high and the other for a lower potential. The method of building up the bus bars by means of thin wide bars separated by an air space is shown in the cut. The method of connecting the switch studs to the bars by means of nuts compressing copper strips will be noticed. The dynamo switches are of the double-throw type, so that they may be connected at will to either the "high" or "low" bus. The ammeters are of the edgewise pattern and occupy a width of but four inches. The pointers move up and down in the arc of a vertical circle—an upward movement indicating an increase in current. Directly under the ammeters are the cutting-in galvanometers, already referred to, which are also made on the edgewise system, an upward movement of the pointer indicating that the generator is at a higher potential than that of the bus bars. Below the dynamo switches are placed the field regulating switches for varying the potential of the generators. These are very compact and consists of a series of contacts, over which the hand-wheel containing another contact is moved. The rheostat proper is located under the floor of the switchboard gallery and is connected to the regulating switch contacts by means of an 80 conductor cable passing up through the ornamental column shown at the bottom of the panel. The pilot lamps illuminating the ammeter dials and the small switches connecting the cutting-in galvanometer to either set of bus bars will be noticed.

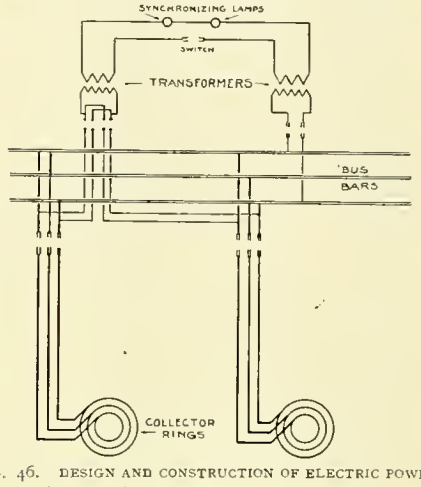


FIG. 46. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—DIAGRAM SHOWING METHOD OF RUNNING ALTERNATORS IN PARALLEL.

Fig. 45 represents the connections on a switchboard for a large isolated electric plant in the Chicago Board of Trade. The board is eight feet high by 27 feet long, and is composed of nine panels of white marble 1½ inches thick. The three center panels are for the generators and contain an ammeter and voltmeter at the top, an automatic circuit breaker, two sets of three-pole switches and a regulating rheostat. The two sets of switches are for the purpose of connecting the generators at will to either the elevator or to the lighting bus bars. The lighting bus bars carry the lighting circuits controlled by switches *7*, *8* and *9*, and also the small motor circuits controlled by switches *1*, *2*, *3*, *4*, *5* and *6*. On the main lighting bus bar is placed a recording wattmeter, which measures all the energy delivered from the generators to the light and motor portions of the plant. A recording wattmeter is also placed in the elevator bus bars to measure the energy furnished to the elevator circuits controlled by switches *18*, *19*, *20* and *21*. By measuring, in this way, all the electrical energy produced, and by means of the arrangements in the plant for weighing the amount of coal and water used, the operators are enabled to keep accurate daily records of the cost of fuel per kilowatt hour. Switches *16* or *17* are for the purpose of charging the auxiliary storage battery, either from the lighting or the elevator bus bars. Switch *23* when closed furnishes current for driving the booster motor, and at the same time for exciting the fields of the booster dynamo. Switch *22* when up allows the booster dynamo to charge the end cells of the battery separately; when down connects the booster armature in series with the charging current from the lighting bus bars.

It will be noticed that the right-hand set of switches on each generator panel is made double-throw. The connections are arranged so that when the switch is thrown up it connects the compound wound generator to the three elevator bus bars as usual, but when the switch is thrown in the down position it cuts out the series winding of the generator and makes the equalizer the positive lead, thus making the generator operate as a shunt machine. This enables the generators to run as shunt machines in parallel with the elevators and storage battery as a perfectly automatic system. When the elevators are not running the generator charges the battery, but when the starting of the elevator motors makes a heavy demand for current the battery responds and assists the generating unit in carrying the excessive load.

The segments of the end-cell switches, shown upon the lower part of the two right-hand panels, are connected to the cells correspondingly numbered. These switches serve the purpose of cutting in or out the end regulating cells of the battery in order to vary its effective voltage, either on charge or discharge. The battery circuit is provided with an overload and also an underload switch, to protect the cells from an excessive charge, or from sending an excessive reverse current back on the board in case of accident.

All ammeters on the board are of the shunt type, and all in distributing lighting and motor circuits are provided with fuses placed on the back of the board. The motor rheostats are mounted upon the back of the board, with the regulating wheel projecting through the marble. A passageway about three feet wide is provided, so that the connections on the back of the switchboard are easily accessible.

The arrangement of a switchboard to control a number of series arc lighting dynamos allows of a much more compact design than that required for the same number of power generators. The switches for controlling the machines are located, as a rule, on the dynamos themselves, or perhaps on a small auxiliary board convenient to the generators. At the switchboard each generator is provided with two sets of heavy spring jacks, one for its positive, the other for its negative lead. Each outgoing lamp circuit is also furnished with a similar set of spring jacks. By means of wire cords having both terminals fitted with suitable plugs it is possible to connect any dynamo with any circuit or circuits or to run the dynamos in series in any way that may be desired. Each terminal should have at least two jacks, so that the combinations of machines and circuits can be changed at will without breaking the circuits. Each dynamo should be provided with an ammeter, which is mounted upon the main board. It is often found desirable also to have an ammeter for each lamp circuit, and with some makes of arc dynamos some form of regulating apparatus is placed upon the switchboard.

Switchboards for controlling alternating circuits are also built in panel form, but, as the current handled at

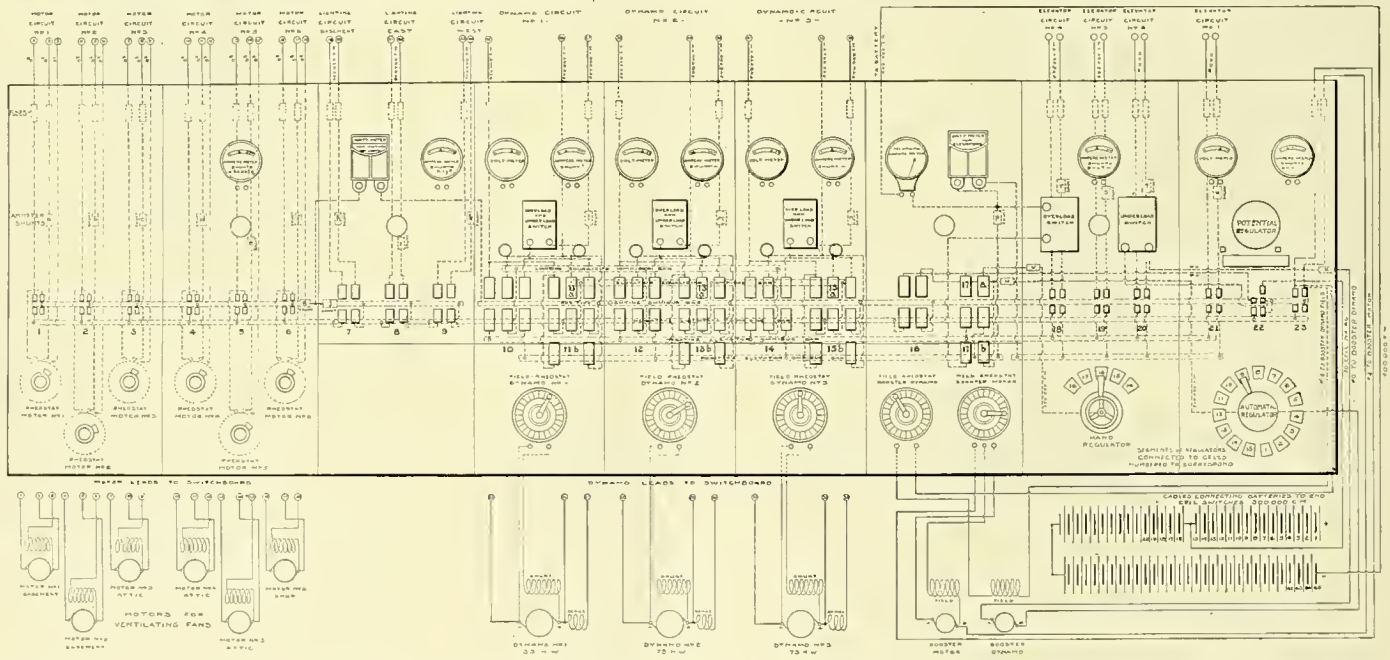


FIG. 45. DESIGN AND CONSTRUCTION OF ELECTRIC POWER PLANTS.—LARGE ISOLATED PLANT SWITCHBOARD WITH STORAGE BATTERY CONNECTIONS (CHICAGO BOARD OF TRADE).

the switchboard is the primary and of high voltage, much smaller conductors can be used than for an equal amount of power in the form of direct current of less voltage. Each generating panel will contain a main pole switch, an exciter switch, main circuit fuses, a voltmeter, an ammeter, ground detector, voltmeter switch, field rheostat and exciter rheostat. Mounted upon the back of the board will be a lightning arrester and a transformer for supplying current to the switchboard pilot lamp. The main circuit switches are not intended to open the primary circuit, as such an operation would result in a destructive arc. The switches should be designed in regard to carrying capacity according to the principles laid down for direct current switches, but the blades carrying opposite polarities should be farther apart. If they are of an approved quick-break type and mounted on the back of the board, with an insulated handle projecting through the marble, so as to be manipulated without danger in case of emergency, so much the better.

Alternating current dynamos can be operated in parallel in the same way as direct current machines, but special precautions must be taken to get the generators at exactly the same frequency before they are thrown in together and to maintain them at the same voltage and speed while in operation. If two alternators in multiple are not "in step," the lagging machine will receive current momentarily from the other generator and run as a motor, thus transferring all the load upon one dynamo. The switchboard connections will be very similiar to those already shown as necessary to operate direct current machines in parallel, and are shown in Fig. 46. Each main lead from the generators will have a switch to connect it with the corresponding bus bar, and in addition an equalizing switch should be provided to connect the corresponding commutator leads. For the purpose of telling when the two alternators are running at the same frequency it is usual to mount two transformers on the back of the board, the primary of one being connected to the common bus bars and the primary of the other arranged to be connected at will by means of a plug switch with the alternator with which it is intended to connect in multiple. The secondaries of the transformers are connected in opposition, but in series with two incandescent lamps, which indicate, by remaining dark, when the machine to be thrown in is in synchronism with those already on the circuit. The relative speeds of the two machines are regulated until the lamps indicate that they are in step, when the main bus bar switch can be closed. No attempt should be made, however, to run alternating current generators in parallel unless they have been designed for such service, in which case them anufacturers will furnish complete directions for their operation.

[The title of the next lecture is "Storage Battery Auxiliaries."]

Convention Notes.

[*Continued from page 349.*]

The popular western representative of the Bryant Electric company was one of the first to arrive. Mr. Grier brought Mrs. Grier, but she was unable to remain during the entire convention period.

Of course I. R. Prentiss of the General Electric company was in attendance. Mr. Prentiss is looked upon as one of the most experienced electrical experts, especially in Brush apparatus, in this country.

Col. W. S. Rogers, the special agent of the Brush Electric company of Cleveland, and also now manager and vice-president of the Cashier's Electric Safety Cabinet company, shook hands with many friends.

D. C. Durland took care of the Interior Conduit & Insulation company's interests. Mr. Durland found many interested in hearing of the new wrinkles on the installation and manufacture of interior conduit.

Secretary and Treasurer W. D. Packard of the New York & Ohio company was in constant attendance in the rotunda of the International. Mr. Packard was accompanied by his sister, Miss Carlotta Packard.

Sears B. Condit, Jr., manager of L. A. Chase & Co. of Boston, Mass., told an interesting little story about alternating machine circuit breakers. Mr. Condit is a great smoker, but he did not dare to smoke his own cigars.

"Champion" Henry L. Doherty of the Madison Electric Lighting company and incidentally of the Anti-municipal-control-of-lighting-plants League, was there of course, and it is said that he will be at the La Crosse convention.

Col. T. H. Brady of New Britain, Conn., was one of the original members of the National Electric Light association, and he has never missed any of the meetings. The old-timers gathered about him and exchanged reminiscences.

Charles D. Shain came up, too. Mr. Shain is now selling agent for some of the best concerns in the country, among which are the Weston Electrical Instrument company, the Electric Protection company and William T. Priogle & Co.

President Charles M. Proctor of the Proctor-Raymond Manufacturing company found time to run up from Buffalo during the last days of the meeting and renew his acquaintance with his many electrical friends from both East and West.

General Manager J. C. Hunter of the Hunter Fan & Motor company of Fulton, N. Y., while he would have been more than welcome had he appeared in person to represent his Perfection 1897 pattern of Tuerk alternate ing ceiling fan style, was forgiven through his choice of a convention representative. "Perfection always commands attention," but in this case perfection commanded beauty as well.

W. C. Ballda, general manager of the Utica Electrical Manufacturing company of Utica, N. Y., had a line of switches that attracted marked attention. Mr. Ballda was everywhere and secured for himself the name of the ubiquitous switch man.

E. G. Bernard of the E. G. Bernard company, Troy, N. Y., made his genial presence felt in a manner that kept his company constantly in mind. Mr. Bernard is one of the old timers, and his dynamos and motors in many quarters are standard.

It is a matter of great regret that Manager Speer of the Partridge Carbon company of Sandusky, O., was prevented from coming to Niagara. It was rumored that Mr. Speer had a previous engagement in connection with the meeting of the Shriners at Detroit.

Alfred B. Clements of the California Asphalt company of New York did not bring samples of this product, but had very interesting circular matter, which was distributed profusely about the hotel and strongly identified this concern with the electrical interests.

Of course George Cutter of Chicago could not stay away, and it was a pleasant occasion for him in that it afforded him an opportunity to talk over old times with Prof. Elihu Thomson, under whom Mr. Cutter served in the early days of the Thomson-Houston company.

E. H. Heinrichs, advertising manager of the Westinghouse Electric & Manufacturing company, was of course in attendance, but this time Mr. Heinrichs brought with him Mrs. Heinrichs, in order that she might use the opportunity to visit the sights of Niagara under most favorable auspices.

The loadstone among the attractions at the convention, outside, of course, of the great power station, was the works of the Carborundum company. Secretary W. H. Arison was indefatigable in his efforts to entertain the great number of delegates which from time to time visited this most interesting plant.

D. E. Newell of New York had a sample of the new para-pneumatic pulley which attracted no little attention, and it was indicated that managers of central station plants might well investigate the strong claims made in regard to it as to the saving of power and slipping of belt.

C. S. Tolles, representing the Jewell Belting company of Hartford, came up with the New York delegates. He did not bring his belts, but he showed samples of the high grade of leather used by this institution in the form of a beautiful pocketbook which was eagerly sought by members.

In parlor 184 President Henry B. Cutter of the Cutter Electrical & Manufacturing company of Philadelphia, assisted by New York Agent H. B. Kirkland, showed the various apparatus manufactured by this concern, and it was without question an exhibit which commanded attention.

Secretary A. H. Pease of the Hart & Hegeman Manufacturing company of Hartford was in evidence everywhere in and about the hotel rotunda. His cordial reception by a host of friends reminded him that it was his duty every year to attend the gathering of distinguished electrical men.

The Bryant Electric company of Bridgeport, Conn., was represented by Manager W. C. Bryant, E. M. Scribner, L. W. Eaton and Captain J. B. Hubbell. The renewing of old acquaintances occupied the time of these gentlemen, and they made no effort to exhibit any of the Bryant productions.

Judge E. A. Armstrong, ex-president of the association, with Miss Elizabeth Armstrong and Miss Carrie Morgan, arrived on Tuesday from Camden, N. J. The greetings given to this party by their friends and the renewal of old acquaintances were pleasant social features of the convention.

The Phœnix Glass company of New York, whose long connection with the electrical business has made it so well known, was represented by E. H. Peck, whose usual push and energy have been seen for years with results that must be flattering to his credit, and this convention was no exception.

John McGhie, in charge of the advertising department of the General Electric company, was, as usual, one of the hardest worked men in attendance. With his usual pleasant manner everyone received courteous attention, and it was again demonstrated that he is the right man in the right place.

The American Circular Loom company was represented by General Manager H. H. Brooks, who had in his cosy parlor samples of his product and who sprung a surprise upon the visitors in the shape of a steel conduit which is called "electroduct." This proved to be an attraction that crowded his parlor.

James Wolff of the Chicago office of the New York Insulated Wire company was on hand, and his genial and courteous manner kept his company well in front. It is contended by those well informed that an electrical convention nowadays would not amount to much had it not Wolff among its delegates.

H. C. Adams, Jr., the courteous representative of the Phillips Insulating Wire company of Pawtucket, R. I., did himself proud in the manner in which he murmured those convincing little pointers relative to the wire that is "O. K." in more senses than one. Mr. Adams is most welcome at every convention.

The Walker company presented a very strong force at the convention, in being represented by General Sales Agent H. McL. Harding, assisted by J. Holt Gates of Chicago, A. F. Moore of Pittsburg, H. B. Abbott of Cleveland, W. A. Johnson of Toronto and H. B. Gay of Baltimore. The scattering of such a large force among the delegates was soon reflected in the comments upon Walker apparatus and the calls for their circular matter at their headquarters.

R. B. Corey was in evidence everywhere as of old. His long connection in the business shows that his popularity is well deserved, and in his new connection of representing the Columbia incandescent lamp and Simplex wires and cables in New York city he should be, and undoubtedly is, meeting success.

General Manager S. M. Hamill of the Brush company of Cleveland found time to drop in and mingle with the boys. Mr. Hamill now spends a great deal of his time looking after the interests of the Brush apparatus throughout the East, but Mr. Hamill is almost ubiquitous, and he is found as often West as East.

One of the most interesting and unique mechanical and electrical exhibits was that of C. C. Gartland, who showed a model of a new arc dynamo regulator. This device is especially applicable to numbers 9, 10 and 11 latest type Brush arc dynamos. Mr. Gartland's address is 370 Maryland street, Buffalo, N. Y.

Luther Stieringer, the well-known electrical exhibition expert, was of course in attendance. Mr. Stieringer's electrical work in connection with the numerous electrical and other expositions throughout the United States has made him famous, and in this case, as in others, he could not afford to be absent.

In company with General Manager Leech of the Keystone Electric company, H. H. Whitacre was decidedly in evidence. Mr. Whitacre is one of those hustlers that makes good use of the splendid points embodied in the Keystone machinery, and he made many additional friends for his company during his stay at Niagara.

The Peru Electric Manufacturing company of Peru, Ind., exhibited at the door of the rotunda of the International Hotel a very handsome board covered with the company's well-known porcelain specialties. The company calls attention to the very important point that its porcelain is burned with natural gas at 4,000° Fahr.

Weston instruments to-day are used everywhere, and there are many newcomers in the electrical business who would have felt highly honored to grasp the hand of the distinguished inventor of these standard instruments. Prof. Edward Weston for some reason was prevented from appearing, and he was greatly missed.

Where is Paiste? was the inquiry continually heard in and about the hotel. Of course everyone knew whom this referred to, and one was constrained to wonder where he had been "switched off," but Philadelphia might "a tale unfold." H. T. Paiste is usually enrolled on the register, and the failure this time was unpardonable.

It must have made the ears of Secretary C. E. Newton of the Jewell Belting company unusually warm during the convention. Many were the inquiries for "Charlie," and it has not been ascertained yet why he did not follow his usual custom and appear before the end, but it is said that he got lost in Detroit and was found among the Shriners by "friends." "Poor Charlie!"

President Keelyn of the Western Telephone Construction company, Chicago, has usually seen fit to send representatives and more or less of an exhibit to every electrical convention, but men could not be spared to devote time to the national convention this year. Mr. Keelyn is one of the most agressive telephone men in the field.

John Knight, general manager of the Oswego light and power station of Oswego, N. Y., was in attendance at the convention, and was an interested observer of the exhibits, etc. His long connection in the arc light business, both as an inventor and practical electrician, has been of good service to him in his new business connection.

General Manager S. V. Morrin of the Clonbrock Steam Boiler company of Brooklyn failed to attend, but it nevertheless took nothing of the glory from that 25,000 horse power installation at the Tennessee Centennial Exposition at Nashville, Tenn. This company claims heating surface 50 to 1 of grate, and absolutely no dead points in circulation.

J. H. Shay represented the Charles Munson Belting company of Chicago. Mr. Shay is so well known that introduction would not be in order in the electrical business. His headquarters are now at the new store on North Fourth street, Philadelphia. He reports a larger increase in trade of late, and states that the outlook for the future business is bright.

A "cake walk" which was given by J. H. Dale and John Carroll in the reception room of the hotel on Tuesday evening was hugely enjoyed by a big crowd, and the features which were supposed to hit several of the prominent visitors brought forth applause. Master of Ceremonies E. H. Peck presided over this enjoyable occasion in his usual successful manner.

It was expected until the last moment that W. R. Brixey of Kerite fame would be in attendance, as he is one of the old stand-bys, but at the last moment he was prevented from coming. Mr. Brixey is usually in evidence at conventions, and many were the inquiries for Brixey. Kerite, however, was looked after from afar in Mr. Brixey's usual, aggressive manner.

General Manager Vincent G. Apple of the Franklin Electric Manufacturing company, Miamisburg, O., appeared on Thursday and was warmly welcomed. Mr.

Apple is one of the most energetic manufacturers in the electrical line, and his small motor is now looked upon as one of the standard toys in this country; the sale of it has been phenomenal

H. M. Underwood of the Marquette building, Chibago, was most energetically in evidence among the electrical frequenters of the rotunda in the International. Mr. Underwood represented the Cloos junction box for high potential currents, alternating and direct and also made "a great hit" with his duplex lamp guard. Mr. Underwood is a hustling salesman.

Miss H. Billings, the assistant secretary, again demonstrated her peculiar fitness for a position involving so much arduous and trying labor in the matter of annoying details. It has been remarked that the convention would not know what to do without Miss Billings, as her courtesy and efforts to please everybody connected with the association have been remarked time and again.

General Manager J. F. Stevens of the Keystone Electrical Instrument company of Philadelphia had a very fine exhibit of instruments at the Cataract House. Delegates were very warm in their praises of the hospitable reception which was extended to them. Mr. Stevens always knows how to do a thing in the right way, and this company was never more forcibly presented to the electrical fraternity.

President John C. Boss of the Lakon company found time to run up from Elkhart, Ind., and mingle with the delegates. Mr. Boss is one of Elkhart's leading citizens and is looked upon now as one of the most successful transformer manufacturers in this country. A recent increase to his plant places him in position to turn out his productions so as to fill, in a reasonable time, all demands on the factory.

General Manager H. A. May of the Electrical Engineering & Supply company of Syracuse, N. Y., was in attendance at the convention, renewing his acquaintance among the central station men. His long connection with this company has evidently fitted him for the responsible position which he now holds, and he reports that his company is having a very large increase in business of late.

Where was Col. Beetle of the Western Electric company? As Col. Beetle is one of Chicago's most popular business men and has been a constant attendant at conventions, it is not to be wondered that his host of warm friends were anxious to have him join them at Niagara. But someone whispered that maybe the colonel was on one of those "still hunts" that usually result in a $40,000 or $50,000 contract.

Elmer P. Morris had a large exhibit in rooms E and F at the Cataract House, where were seen the various samples of electric lighting supplies, etc., which were a point of attraction for the delegates. One of the pleasant items in regard to this was the fact that the entire exhibit was sold during the second day, and out of courtesy of the purchasers it was allowed to remain until the finish of the convention.

Electrical Engineer C. H. Wilmerding, who has been spending a week or so in New York organizing his new engineering enterprise, was constantly on hand. Mr. Wilmerding has opened an office in the Old Colony building, Chicago. During his visit to New York he made arrangements with the Crocker-Wheeler Electric company to take general charge of this concern's engineering work in the west.

New York Agent P. C. Ackerman of the American Electrical Works of Providence presented the visitors of the convention a fac-simile of the feeder cable used for the Niagara Falls and Buffalo transmission, very tastefully gotten up as a souvenir to be used as a paper weight; and the large number of calls upon him for this useful article soon exhausted the supply. Frank B. Baker accompanied Mr. Ackerman.

T. E. Adams of the Adams-Bagnall Electric company was on hand and made an interesting exhibit of four of the Adams-Bagnall Electric company's most improved arc lamps. Mr. Adams showed the series enclosed arc type and also the regular open arc type. It was a matter of regret that he had no current for his alternating lamp or his constant potential lamp, but the exhibits made the usual excellent impression.

General Manager James I. Ayer of the American Electric Heating corporation of Boston, Mass., was a close attendant of the meetings in the convention hall. He was unable to present a full line of his company's manufactures, but reports that the company is now preparing a new line of motor starters and controllers, embodying a form which is expected to meet the most rigid demands for the protection of motors.

Joseph Kettlestrings of the Midland Electric company was in attendance to exhibit a new enclosed arc lamp. Mr. Kettlestrings is a man that has devoted an immense amount of work and study to the perfection of the arc lamp, and his exhibit attracted considerable attention. The Midland Electric company is at 1564 Monadnock building, Chicago, and those interested in the perfection of enclosed arc lamps might do well to inspect this lamp.

The Sunbeam Incandescent Lamp company came to the front as usual in the person of its energetic and active manager, F. S. Terry. Mr. Terry joined forces with the Western Electric contingent in extending the hospitalities to both companies' many friends. Mr. Terry is now actively engaged in pushing the Sunbeam lamp interests in connection with the Western Electric company, and is doing good work in this direction.

Treasurer A. O. Shepardson of the New England Engineering company of Waterbury, Conn., was able at the last moment to leave his business and go to the convention He reports that the company has a large amount of construction work under way at present in various portions of Connecticut, and that the central station construction work is particularly active at present in the extending of new lines, etc.

The new ideas presented by the Hope Electric Appliance company in switches upon a wooden slatted switchboard was such a marked departure that the exhibit was surrounded continually by visitors who were persistent in their demands for explanations in regard to the apparatus. President Robert Fessenden and General Manager J. I. Drake were untiring in their efforts in meeting requests of investigators who called.

The Simplex Electrical company of Boston, Mass., was represented by General Manager J. H. Mason, who expressed himself as being very pleased at the large attendance at the convention and the evident new interest which seemed to be waking in the electrical business, and reported that the outlook with them had never been brighter during the past year for a large increase of business. Where was Hixson of Chicago?

General Manager J. H. Astruck of the Pioneer Electric Arc Light company did the honors at the International in royal style in company with Prof. Louis B. Marks, chief electrician. At the company's quarters were seen several of its interior arc lamps, each one presenting special features of itself, while on the veranda were several of the 100-hour outdoor styles in operation, which also attracted no little attention.

Marcus Nathan and B. E. Greene represented the interests of the Grand Central Palace of New York in presenting an invitation to the Electric Light association to hold its next annual meeting or exhibition in New York city, and with it stated that if it were not convenient to have the next meeting held in that city, at any future time their services were at the disposal of the association in any way to bring about or increase a line of exhibits for a meeting.

General Manager C. S. Knight of the Fort Wayne Electric corporation and the new Fort Wayne Lamp company was most decidedly in evidence, backed as he was by the usual large Fort Wayne convention contingent. Accompanying Mr. Knight were C. H. Philbrooke, F. A. Wunder, J. H. Finney, Thomas Cooper, J. C. Lott, James J. Wood and Prof. Thomas Duncan. The goods especially pushed by these gentlemen were Fort Wayne meters and lamps.

Electrical Engineer G. A. Scheeffer of the Diamond Electric company of Peoria, Ill., was on hand and made a very attractive exhibit with his well-known Standard meter and transformer of the Diamond company. Mr. Scheeffer also exhibited his new Cardaw earthing device. This latter, however, will have to be seen to be appreciated, and a line to the Diamond Electric company will bring full explanations of an interesting electrical adjunct.

General Eastern Manager George Wiley of New York and T. E. Hughes, manager of the wire department of that company, represented the Standard Underground Cable company of Pittsburg. They had an exhibit in Parlor G, showing samples of high and low-tension electric light cables with fiber, rubber and paper insulation, and a numerous number of small covered wires. They had their usual large number of callers.

Habirshaw wires and cables were impressed upon everyone by the pretty little badges with national colors that were presented by General Sales Agent J. W. Godfrey and F. W. Harrington of New York. The India Rubber and Gutta Percha Insulating company is always a strong feature at the conventions, but the addition of President W. H. Habirshaw at this time made its headquarters one of the most popular resorts.

President Samuel Insull and General Superintendent Louis A. Ferguson of the Chicago Edison company were on hand during the entire convention period. Mr. Insull's plant in Chicago is now looked upon as a model, not only in this country but abroad, and the success of the Chicago Edison company under his policy in regard to both financial and technical matters has been phenomenal. Mr. Ferguson was congratulated by his many friends on his recent advancement.

Secretary A. D. Newton of the Eddy Electric Manufacturing company was present at the convention, assisted by New York State Agent S. N. Blake of Elmira, N. Y. In company with the Eddy people was President John A. Stewart of the Stewart Electric company of Cincinnati. Mr. Stewart not only represents the Eddy company in his territory, but he does an extensive repair and second-hand business as well. Expressions of regret at not meeting General Manager M. E. Baird of this company were heard on every side and attested to his popularity.

What would be a convention without E. Ward Wilkins of the Partrick & Carter company of Philadelphia? He has never missed one of these gatherings, and indeed it would seem that the convention was not complete without him in attendance, and the cordial reception which he received fully demonstrated his popularity in the trade. A small but choice selection of specialties under the care of Thomas L. Townsend was seen in the rotunda of the hotel.

Where was President William H. McKinlock of the Metropolitan Electric company, Chicago? Mr. McKinlock wasn't there, that is certain. He should have been on hand to meet his host of New York friends. Many were curious to see the man that has the distinction of publishing one of the largest and most attractive catalogues that the electrical supply business has ever seen. Mr. McKinlock had expected to be on hand, but a pressure of business at the last moment prevented his appearance.

If there is one man that should have been at the convention, if only for the sake of old times, it was President C. C. Warren of the Warren Electric Manufacturing company of Sandusky, Ohio. Mr. Warren, however, was in the throes of arranging the final details about his fine new factory in Sandusky, Ohio. Orders have begun to come in for the Warren alternator, and for this reason Mr. Warren was unable to make an exhibit of the remarkable features of the Warren alternator.

One of "the pebbles on the beach" that made himself felt in more ways than one at the convention was E. H. Allen of the Beacon Lamp company. Mr. Allen is the new western representative of the Beacon Lamp company, with headquarters at 1141 Monadnock building, Chicago. Mr. Allen is one of the most aggressive salesmen in the West, and, as he explains it, "operates outside the trust." Mr. Allen states that he has found that the stand of his company has resulted in a most remarkable increase of business.

Master of Transportation C. O. Baker, Jr., as usual arranged all details for the special train from New York and the general train arrangements from Boston and Chicago to the convention. Of course there was no hitch in the affair; there never is when he has them in hand. Everything resulted in another success to his credit, until now, as many delegates said, "we could not have a convention without Mr. Baker in charge of transportation." His unusual patience under trying circumstances was many times commended.

The New York Insulated Wire company was ably represented by P. H. Hoover. Mr. Hoover did not bring samples with him, but the long, quiet talks he had with numerous gentlemen that were said to be prospective purchasers made him conspicuous to such a degree that he adjourned for a long carriage ride around the Falls, and, it is said, that when he returned he had something more in his pocket than when he started for the drive, and it was whispered that it was a good order.

R. C. Foster of the Cornman company, assayers and refiners, Cleveland, Ohio, and also of the Schneider Manufacturing company, mingled with the boys and revived his memory of the old-time acquaintances made during his connection with the Brush Electric company in the financial department. Mr. Foster added many to his already large line of friends. Mr. Foster was accompanied by his mother, who enjoyed herself with the ladies seeing the sights of Niagara.

The Standard Paint company of New York through its agents, H. W. Benedict of New York and F. S. Howard of Chicago, presented one of the most beautiful souvenirs seen at the convention. It was a white leather card case which could be used both for business and social occasions, and was in such great demand that the supply was soon exhausted. The above gentlemen as usual placed the well-known trademark of P & B everywhere so that it was continually before the eyes of every visitor at the hotel.

The display shown by the Bossert Electrical Construction company of Utica, N. Y., of circuit breakers, standard steel armored slate lined junction boxes and steel drawn wall and outlet boxes was one of the most complete exhibits in this line seen at any convention for many a year; the perfection of detail and workmanship was a matter of much favorable expression by visitors. President W. F. Bossert, assisted by W. D. Pomeroy, exhibited a genial hospitality and patience in explaining at length the merits of the apparatus.

The exhibit of Macintire arc lamps manufactured by the International Arc Lamp company of New York was seen at Parlor 300 of the Cataract House in charge of Geo. R. Macintire. This beautiful and artistic exhibit attracted a great deal of attention, and the comments of the visitors showed surprise at the progress in arc lighting for home and office installation. It seemed to present an old subject in new dress. The striking catalogue which was presented by this company was filled with beautiful designs of its manufacture.

The Puritan Electric company of New York was represented by General Manager Stuart W. Wise and the Boston agent, M. H. Baker. The Puritan alternating lamp was seen at its best in one of the new designs in the rotunda of the hotel, and was the center of an interested assembly of central station men, who also found on the veranda three of the 100-hour lamps of this company in operation, and expressions of favorable comment were heard on every side in regard to the perfect operation of the lamps; and as a result large orders were taken for future delivery.

General Manager R. F. Requa of the Safety Insulated Wire & Cable company of New York did not reach Niagara until the second day of the convention, but his excuse for not being present before, owing to the fact that important business called him to Detroit, Mich., where he closed the business for underground cables for the third year with the public lighting trustees of that city, was accepted as a good one. This concern also, as it is well known, furnished the cables in connection with the Cataract Construction company.

Charles I. Hills, New York manager of the Perkins Electric Switch Manufacturing company of Hartford, was extended his usual hearty welcome at the convention Although a young man he is classed among the veterans in the electrical trade; and there are but few who have traveled more miles and been more successful in this line. The visit of Mr. Hills to the convention was not without reward, and of such a nature that, as it

proved, he would have regretted it had he not been in attendance.

The Belknap Motor company of Portland, Me., through its New York agent, F. C. Brewster, had an installation of its regulators at work in a prominent location of the hotel rotunda, where it was visited by numerous central station men and others interested in hearing the explanations and examining the Chapman regulator. The company has been very successful in this line of business, and the strong list of references of central stations that are supplied with this apparatus shows the value of the device.

"Charms strike the eye but merit wins the soul." This little motto of the Phœnix Interior Telephone company in a few words tells the story that this company believes not only in a handsome appearance but merit as well. The Sutton microphone, which is being exploited by this company, is a remarkable instrument, and should be tested by those making extensive purchases of such apparatus. The company, too, takes a very strong position in the matter of protecting customers from any possible annoyance in the matter of suits.

General Manager Fox of the Northern Electrical Manufacturing company, Madison, Wis., was prevented from exhibiting one of his direct-connected motors. The Northern Electrical company is making a specialty of direct-connected motors and is meeting with remarkable success, as the company works only under the highest scientific methods of installation, and those contemplating the installation of direct-connected motors would find it to their interest to secure estimates from the progressive Northern Electrical company.

The H. B. Lamp company, in the person of A. L. Daniels, held forth in the rotunda of the International. Mr. Daniels was in constant attendance from early morning until late at night, and there were few present that did not know fully and appreciate the merits of the H. B. Camp company's vitrified clay conduit for underground electric wires, its porcelain lined steel-armored insulating conduit for interior wiring. The shipping station of this company is at Greentown, O., and it is now in a position to furnish complete underground and interior conduit systems.

"Silver tongued" Thomas R. Mercein, or more properly the genial and courteous secretary of the Northwestern Electrical association, was one of the most active men at the Niagara convention. Mr. Mercein only decided to join the crowd at Niagara at the last moment, but the wisdom of his decision was evidenced in the fact that he secured, it is stated, over a dozen new members for the Northwestern Electrical association. Mr. Mercein is one of the most popular electrical men in the Northwest, and justly so, from the fact of his untiring efforts for the general good.

The word "Okonite," besides being one of the household names of the electrical business, has become a word that identifies itself with novelties in the way of souvenirs, which the delegates of conventions immediately begin to ask for. This year a key to their headquarters which could be used as a pencil and served besides to show in a very unique way the trademark for the handle, was eagerly sought after, and an extra supply had to be sent for in order to satisfy the demand. Capt. W. L. Candee and General Superintendent George T. Manson presented the hospitalities of this company.

Assistant General Manager M. L. Livingstone of the Standard Thermometer & Electric company of Peabody, Mass., renewed old acquaintances from the West, and was one of the very busy men about the International. On account of the short length of his visit he was not able to have an exhibit of the arc lamps made by this company. However, the many inquiries made of him in regard to the new Midget and the high-tension series lamps, which Mr. Livingstone reported were now working successfully in street lighting and commercial circuits, prevented him from leaving on Wednesday, as expected, for Chicago.

It was really a matter of duty on the part of Secretary John C. Fish of the Shelby Electric company to have come to the front. But Mr. Fish having acquired an exceedingly high degree of modesty from an eight years' experience in the water works department of the John H. McGowan company of Cincinnati, feared to attempt to stand the strain. Mr. Fish is a most courteous gentleman and does the honors to all visitors to Shelby in the most hospitable manner. He has certainly made a wonderful progress, too, in the matter of establishing his incandescent lamp interests on a substantial basis.

The H. W. Johns Manufacturing company was represented by W. F. D. Crane of New York. The exhibit was situated in the lobby of the International Hotel and consisted of an interesting display of electrotherm heating pads and electric car heaters, both of which were shown in operation; and samples of the new giant arc light hanger, toggle-clamp, feed wire insulator, weatherproof sockets and insulating pieces made of moulded mica and Monarch compounds for all kinds of electrical apparatus, including vulcabeston spools and parts for arc lamps, insulating sheets for lining cut-out boxes, backing switches, motors, etc.

Secretary James P. McQuaide of the National Conduit & Cable company of New York was as usual doing that everlasting hustle for which he is so well known. There was something else besides samples of cable in his pockets. A knowing one said that there was a large order placed carefully away to accompany him to New York. This company's large installations throughout the country are well known to all electrical interests, and the recent work at Montreal has attracted a great deal of attention, and this was one of the leading topics of conversation by those interested in this class of work.

President J. H. Rhotehamel and Secretary and Treasurer A. C. Garrison of the Columbia Incandescent Lamp company came up from St. Louis. The Columbia company reported a fine business, and there is no question but that this company deserves a good share of the business through its producing such a high-class production. Messrs. Rhotehamel and Garrison have always been the champions of strictly high-class lamps, and this policy has been adhered to year in and year out and is now bringing the company continued patronage that makes it one of the most substantial lamp concerns in this country.

It is a matter of great regret to the many convention friends of Secretary and Treasurer T. S. Lane of the Electrical Exchange, Chicago, that he was unable to be present. Mr. Lane had expected to join the crowd at Niagara, but the pressure of business at his Chicago office prevented his attendance. The Electrical Exchange is now looked upon as one of Chicago's most successful institutions, and its unique method of doing business in second-hand bargains on the brokerage basis has met with a most cordial reception all over the United States. This concern has been making a specialty of a new electrical fan and is also pushing an incandescent lamp that is worth trying.

G. O. Rockwood was on hand to represent the Rockwood Manufacturing company, and made many friends. Mr. Rockwood brought with him samples to illustrate the peculiarly valuable features of the well-known Rockwood paper pulleys. He also exhibited a simple but ingenious testing machine to demonstrate conclusively the great advantages of the paper pulley over the iron-faced pulley in the matter of belt slippage and adhesive qualities. The Rockwood Manufacturing company has made a specialty for years of the paper pulley, and the fact of its rapid introduction is an evidence of the value of this especially, in connection with dynamos and other machinery, where a pulley of small diameter is required.

General Secretary and Treasurer J. G. Ruhl of the Mitchell Tempered Copper company of Corry, Pa., made a most interesting exhibit (a cut of which is printed elsewhere in this issue) in the entrance to the rotunda of the International Hotel. Mr. Ruhl was somewhat "under the weather" on arrival, but it is safe to say that there was no one interested in tempered copper at the convention that did not have a chance to inspect his remarkable castings. The Mitchell Tempered Copper company makes a specialty of commutator bars, and its goods are being used by some of the largest users of copper in this country, as, for instance, the General Electric company.

The Armorite Interior Conduit company and the Cummings Conduit company, both operating under the patents of President James F. Cummings of the Armorite company, were represented by Mr. Cummings, Judge McMillan and Mr. Austin of Detroit, the last named gentleman being the general manager of the Cummings Conduit company. The success with which the Armorite Interior Conduit company has met within the last year brought compliments to these gentlemen from all sides, and Mr. Cummings' recent move in establishing the Armorite factory at such a center as Pittsburg, with its many obivous advantages, was referred to as being a decidedly wise one. Mr. Cummings deserves his success.

One of the most unique exhibits was the arrangement of fan motors at the headquarters of the Paragon Fan company. There were 50 fans in pyramid form, all at work. This created a breeze that soon made a loud call for extra wraps. Prominently located at the headquarters of the Paragon company was an affidavit that one of its fans had been running continuously for 2,627 hours General Agent J. P. Williams is to be congratulated upon the exhibit, which was the result of his labors, and a higher compliment could not be paid than when Samuel Insull of Chicago, upon seeing it, at once stated that he desired to purchase it for the Chicago Edison company, and wished it shipped to Chicago as soon as possible.

General Manager M. J. Isaacs of the K. McLennan company, Marquette building, Chicago, was in attendance, and Gale's commutator compound found a large addition to its already large host of friends. Mr. Isaacs is a most indefatigable worker, and the great success of this compound during the last 1½ years is unquestionably due to his energetic and aggressive efforts of impressing its merits upon every possible user. Tests made at the convention showed remarkable results. Mr. Isaacs has been in attendance at every convention since he has taken hold of this specialty, and now his good work is telling in the most flattering manner. Mr. Isaacs was accompanied by Mrs. Isaacs, who ran up the country on a short trip during her husband's hard work at the convention.

The valuable services of Secretary George F. Porter were never more apparent than during last week's convention, as it was one of the largest gatherings that had ever been held by the association. The various excursions to the local points of interest near Niagara, which he had arranged, were well planned and executed. A neat little book of coupons, at reduced rates, could be had, which provided for everything that a visitor might desire to see. The perfection of detail in the convention hall showed what long experience and close attention to such gatherings can accomplish. Mr. Porter received the most hearty congratulations from everyone for scoring an even greater success at this convention than at any of the past.

General Manager Herbert A. Wagner of the Wagner Electric Manufacturing company attended the convention in company with F. Schwedtmann. Mr. Wagner brought with him a two horse power single-phase alternating current motor to show the delegates the operation of his new type of motor. The Wagner company has recently gotten out also a remarkably fine line of continuous current apparatus as well as the single-phase alternating line. This alternating motor exhibited by Mr. Wagner attracted much attention, as he is looked upon as one of the best authorities on alternating current in the United States. On all sides, however, were heard expressions of regret that Manager of Sales E. H. Abadie of the Wagner company was detained in St. Louis by pressure of business. Mr. Abadie has been a constant attendant at conventions, and it was expected of course that he would be at this one.

General Manager C. E. Bennett, Jr., of the Diehl Manufacturing company of Elizabethport, N. J., was ably assisted by B. C. Kenyon in presenting the merits of the ceiling fans manufactured by this company which are so well known among central station men; and the circulars which were distributed by them, showing the new electrolier and column fan, were quickly taken up by those interested. These fans can be successfully operated upon a 500 volt circuit, either singly or in series of two fans, as each fan contains its own motor directly coupled to the fan shaft, and is provided with an indestructible commutator. Mr. Bennett has an extended acquaintance among the central station men, owing to his connection with the business for several years past at the Oswego, N. Y., electric light station.

S. F. B. Morse & Co. (S. F. B. Morse and J. D. Earle) appeared in type at the convention, but that did not seem to fully satisfy. Messrs. Morse and Earle had expected to appear, but at the last moment decided that it would be impossible to join the convention. The new firm has only recently organized itself into anything like working shape, but if previous experience is any sign the coming year will be a prosperous one for the new and popular firm. For some months Mr. Morse has been actively engaged in securing a fine line of eastern agencies. It has been his plan to secure a few of the very best in the market and devote his attention strictly to these. It is needless to say, however, that S. F. B. Morse & Co., will continue to pay the closest attention to supplying their large and permanent trade with high grade insulating wires and cables.

President George A. McKinlock of the Central Electric company of Chicago, accompanied by H. E. Adams, New York representative, and P. B. Chaney, Ohio representative, spent the bulk of his time renewing old acquaintances. Mr. McKinlock found his time well taken up with his host of eastern friends, and he was kept decidedly busy in this direction. The Central Electric company is known as one of the most successful supply houses in the United States, so that it is now considered a compliment, and in fact almost an assurance of success, to have it champion any particular line of goods. One has only to visit the immense Adams street establishment of the company and to inspect its modern methods of doing business and facilitating shipments from its extraordinarily large stock to appreciate the success that years of careful, brainy effort has brought about.

But few subjects have been of more interest of late in the electrical business than that of the storage battery in connection with central station plants, and, therefore, it is not to be considered at all strange that General Manager Herbert Lloyd of the Electric Storage Battery company of Philadelphia was continuously surrounded by central station men asking him for data and information in regard to this very important branch of the business. Mr. Lloyd reports that at no time has there been such an interest shown in the storage battery for use in central station and power plant operations as at the present time since he has been connected in the business. It was a matter of great regret, though, that Manager Charles Blizard of the company's New York office had been detained at home by important business that could not be postponed. Mr. Blizard is an able and popular man, and was greatly missed.

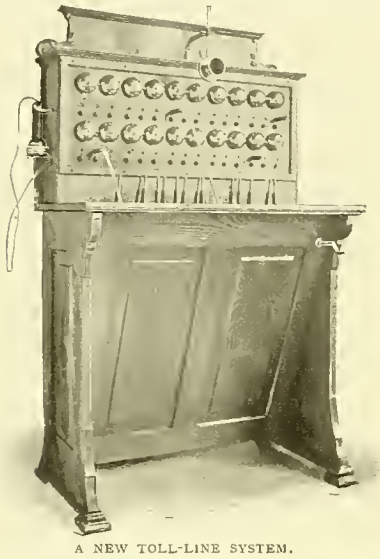
The Jandus Electric company of Cleveland as well as the Buckeye Lamp company of the same city were decidedly in evidence in the persons of General Superintendent George R. Lean, E. L. Nash of the Philadelphia office and Bailey Whipple of the Buckeye Lamp company, also J. R. Massey, superintendent of the Buckeye lamp factory. The Jandus Electric company issued a circular to the effect that it is the owner of the patents of William Jandus and the sole manufacturer of the enclosed arc lamps made under these patents and heretofore sold as "Manhattan." The company has now organized a sales department and will sell the lamps directly to agents, dealers or customers, instead of marketing its products through a general sales agency The standard Jandus lamp is the same as that formerly sold as Manhattan, many thousand being now in use throughout this country and abroad. New designs are now offered and the whole field of arc lighting is covered with our enclosed arcs.

It is safe to say that no one was in greater evidence at the Niagara Falls convention of '97 than President Willard W. Low of the Electric Appliance company, Chicago. For years Mr. Low has paid special attention to the sales department of the Electric Appliance company, and through his contact with the electrical buyers of the United States has become one of the best known men in the supply business of the West, to say nothing of his extensive acquaintance with eastern electrical manufacturers. As a consequence Mr. Low found his time taken up at the convention largely with hand-shaking, and it was a noticeable fact, too, that the president of the Electric Appliance company was sought by a number of manufacturers anxious to exploit their

goods more thoroughly in western markets. Secretary Thomas I. Stacey was unable to attend; he usually delegates this trip to President Low, but had he put in an appearance it is safe to say from the welcome he would have received he would hereafter be one of the most constant attendants. Mr. Stacey is thoroughly known to the electrical manufacturers of this country, as it has been his particular business to arrange for the Appliance company's lines of supplies, and his business-like methods have made him many firm friends.

Much interest was noted in regard to the Trans-Mississippi Exposition to be opened in Omaha next June. Professor Owens, commissioner for the electrical section, reports that many inquiries and applications for space in the electricity building were made by those in attendance. Among the companies who signed for space in the past week may be mentioned: Wagner Electrical Manufacturing company of St. Louis, Mo.; Walker company, Cleveland, Ohio; Okonite company, New York, and the Cutter Electric & Manufacturing company, Philadelphia, Pa. Prof. Elihu Thomson has also signified his willingness to loan his interesting and valuable collection of historical apparatus, as has also the Brush Electric company of Cleveland. Lieut. G. O. Squier will also exhibit his newly invented and remarkable synchronograph recently described before the American Institute and which is soon to be tried by the British government under the direction of the inventor and W. H. Preece. A full display of the applications of electricity to sea-coast defense will also be made.

The Commercial Electrical Supply company of St. Louis had expected to have present at the Niagara convention some representation other than "Little Willie and the Old Man." The company's little advertising hustlers did their work well, however. The "Old Man" got there with flying colors and planted the flag carrying the name synonymous of a successful southwestern supply house firmly on the banks of the Falls. The Commercial Electrical Supply company during the past year has attracted an immense amount of attention



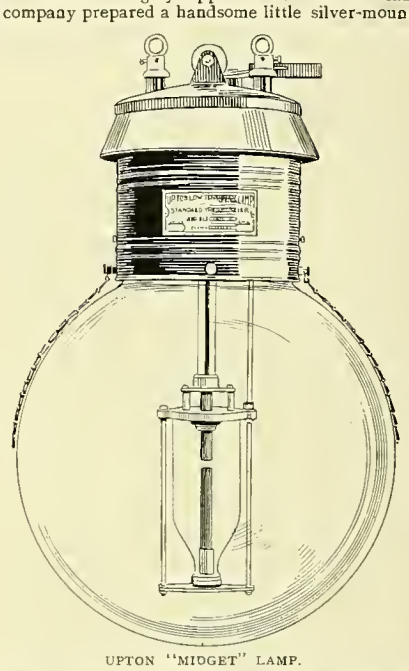
A NEW TOLL-LINE SYSTEM.

through its aggressive campaign that has secured a fine business. The theory of the company has been that the territory with St. Louis as a center should be able to support one of the largest supply houses in the United States, and the company's evident success would indicate that this policy in the matter of liberal dealing and aggressive management has proved most successful. There were a number of St. Louisians at Niagara and it was a matter of regret that President Joseph Franklin, Jr., and Manager of Sales Paul D. Cable had at the last moment to delegate so responsible a task to "Little Willie and the Old Man."

It is said that the exhibit of the Western Electric company in the center of the rotunda of the International Hotel at Niagara was one of the most attractive there. Messrs. Wilkinson and Thomas G. Grier, who had been appointed to take charge of this matter, were clever enough to select the most central point in the entire hotel, and, as someone remarked, to move anywhere you had to see the "most ancient and the most modern fan," the latter in the shape of the new Western Electric column and desk fans. Messrs. Wilkinson and Grier were continually on hand to talk fans, Sunbeam lamps and wire. It had been the intention to distribute Japanese fans carrying a representation of the "most modern" Western Electric fan equipments, but the remarkably cool weather during the convention rather threw a chill on this scheme, but the cold blast of air that continually fed out from the Western Electric table in the center of the rotunda did its work nevertheless, for there was not a man at the convention that was not continually reminded that the fans, at least, were "blowers" in every sense of the word. The Western Electric company has had, from all accounts, a most remarkable record in the matter of the sale of its new fans, and from the handsome external appearance of these goods, to say nothing of mechanical details, they are certainly a most attractive line. But, backed as they are by the reputation of the Western Electric company for the very best kind of workmanship and finish, it is not to be wondered that they have taken with the trade as well as has been the case. In addition to their exhibit Messrs. Wilkinson and Grier distinguished themselves by a number of unique advertisement schemes that redound greatly to their credit as pushers and hustlers. It is a matter of great regret that Manager Tucker of the supply department of the Western Electric company could not be in attendance, but as Mr. Tucker is an exceedingly busy man these days it was impossible. John Young, however, of the company managed to slip in on Thursday to have a glimpse of the boys. A picture of the Western Electric company's exhibit is presented on another page.

Among the exhibits of electrical apparatus the display made by the Westinghouse Electric & Manufacturing company perhaps attracted the greatest attention. It was generally commented upon by the guests and delegates that the exhibit made by the Westinghouse company was not only very complete, but was full of interesting features. Several lines of apparatus were in view and in actual operation. Among them was a 15 horse power 500 volt direct current motor driving a 7½ horse power 125 volt direct current generator and a 10 horse power 100 volt alternating-direct current two-phase generator. From the alternating current circuits was operated a one horse power two-phase induction motor, constant potential arc lamps, induction motors, etc. The circuits were all supplied with the Shallenburger wattmeters, showing their operation to great advantage. A full line of converters was shown, from the smallest size up to a 25 kilowatt converter in oil. The new type of panel switchboards was on exhibition for both alternating current and direct current generators. A full line of lightning arresters was shown, both for arc and incandescent high potential circuits. The Sawyer-Man Lamp company of Allegheny, Pa., had a very attractive exhibit in connection with the Westinghouse display, consisting of lamps of various candle power and voltage. The principal feature of this exhibit was the display of 220 volt lamps. The very long filament necessary for a thoroughly satisfactory lamp of this high voltage is rendered perfectly stable by means of the three-point supporter for the loop, making impossible the short-circuiting of the carbon due to vibration or jarring. Attention was also called to the glass bridge between the leading-in wires, which serves as a support for the anchor, from the stem. It is a well-known fact that a 220 volt lamp, if made after the standard type, is liable to short-circuit across the leading-in-wires. This device renders impossible such short-circuiting. The exhibitions of the Westinghouse Electric & Manufacturing company and the Sawyer-Man Electric company were situated in the south end corner upon the veranda of the International Hotel, where a large parlor and a private office had been engaged. The parlor was very tastefully decorated, and in the front of the windows, as well as in the interior, numbers of incandescent lamps and three constant potential arc lamps illuminated the exhibits at night. A large amount of literature descriptive of the Westinghouse company was also on hand for distribution among the delegates and guests. Good-sized photographs of the apparatus which the Westinghouse company installed at the plant of the Niagara Falls Power company were suspended from the wall and attracted a great deal of attention. The exhibits were in charge of W. K. Dunlap and M. McLaren of Pittsburg, Pa. The Westinghouse company was represented at the convention by the following-named gentlemen: C. F. Scott, Pittsburg; B. G. Lamme, Pittsburg; C. A. Bragg, Philadelphia; T. B. F. Paim, Boston; F. S. Smith, Pittsburg; Maurice Coster, Chicago; Paul T. Brady, Syracuse; T. C. Freneyear, Buffalo; F. N. Waterman, New York; W. K. Archbold, New York; H. P. Davis, Pittsburg; Clarence A. Ross, Buffalo; E. H. Heinrichs, Pittsburg; R. S. Feicht, Philadelphia; Arthur Hartwell, Pittsburg; C. S. Skinner, Pittsburg; C. F. Medbury, Chicago.

The exhibit of the General Electric company at Niagara Falls was small, but dealt with such apparatus as most nearly concerns managers of lighting stations, *i. e.*, elements of improvement in their equipment and means for more accurately measuring and metering their output. Briefly, the exhibits related to arc lighting, meters, transformers, lightning arresters and general appliances. The principal exhibit was a handsome board equipped with a type of every metering and measuring device manufactured by the company. On the board were mounted recording wattmeters of every kind, the principal being a large capacity meter for measuring total station output of 2,500 amperes and over. The meter specially built for the three-wire service of the Edison Electric Illuminating companies was shown beside the power meter for motor service on 500 volt circuits, and the new street car meters designed for attachment to street cars to measure the consumption of current by the car and to act as a check on the motorman. Considerable attention was attracted by the new prepayment meter presently to be placed upon the market. In combination with the meter is a coin-receiving device, by means of which a consumer is enabled to pay for his light beforehand, know how much he has paid, and receive only what he has paid for. The field for this type of meter promises to be very large among consumers able only to use electricity in moderate quantities. The operation of this instrument was very carefully explained to the delegates by Caryl D. Haskins. A Thompson astatic ammeter and an astatic voltmeter were also exhibited, the voltmeter being placed on a circuit of the Gorge railway. It was absolutely deadbeat, the needle being held to its indication without a tremor. The instrument exhibit was completed by a full line of the Thompson inclined coil instruments for both switchboard and portable use. The arc lighting department was represented by samples of the single-solenoid lamp, the long-burning lamp for 220 volt circuits, the focusing lamp for series arc circuits, the inclosed long-burning lamp for 110 volt circuits, and that for alternating current circuits. The simplicity of the mechanism of the latter lamp and its perfect operation created a marked impression upon the delegates. Several were hung under the hotel arcade, and every opportunity was afforded of examining them in operation. This lamp will shortly be placed upon the market. In order to enable delegates the better to comprehend the structure of the lamps, all the different parts were shown unmounted. Samples of the direct current lightning arresters for circuits up to 850 volts formed part of the exhibit, as well as the Wirt short-gap lightning arresters. The type H transformer, the most recent type developed by the General Electric company, also occupied a prominent position in the room. The method of building up this transformer was shown by parts in different stages of construction, and its performance by a series of charts giving the efficiency core loss and regulation curves. A testing transformer for measuring insulation was also shown and explained. It is offered as a substitute for the old methods, and is designed for measuring such insulation as is necessary with the higher voltage currents of to-day. An X-ray set completed the exhibit of the General Electric company. This was shown during the afternoons and evenings, and while in operation attracted large crowds to the rooms. On Tuesday all the foreign delegates to the Postal Congress, under the guidance of General Batchelor, witnessed a special exhibition given for their benefit by F. M. Kimball and Mr. Haskins. The company distributed a tasteful souvenir book, illustrative of Niagara Falls and the work which it has done in connection with the utilization of their power. It also presented the delegates with a "planigraph" or wire calculator. This was highly appreciated. For the ladies the company prepared a handsome little silver-mounted



UPTON "MIDGET" LAMP.

souvenir. The parlors of the General Electric company were decorated with framed diplomas, and with some excellent enlarged photographs of its important installations and apparatus. Its representation included the following-named gentlemen: Prof. Elihu Thomson, S. Dana Greene, W. L. R. Emmett, J. R. Lovejoy, H. C. Wirt, J. M. Andrews, J. W. Kirkland, G. DeB. Greene and J. H. L. Hilman, Schenectady; M. K. Eyre and A. D. Sage, Harrison, N. J.; Charles W. Davis, A. R. Bush, F. M. Kimball, Caryl D. Haskins and S. B. Paine, Boston; W. D'A. Ryan, Lynn, Mass.; C. E. Estabrook and J. McGhie, New York; H. J. Buddy and D. R. Bullen, Philadelphia; J. C. Calish, Pittsburg, Pa.; L. H. Cooper and E. K. Gillette, Cincinnati, Ohio; H. H. Crowell, Syracuse; W. Dixon, Columbus, Ohio; J. P. Judge, Baltimore, Md.; W. M. Ray, San Francisco.

A New Toll-line System.

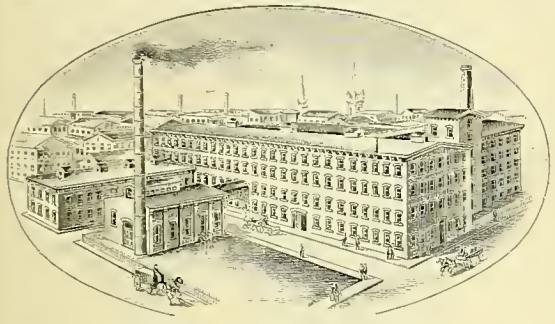
Many devices and systems have been brought forward during the independent telephone movement for connecting local exchanges and toll-line systems, and it may be said of many that while they have supplied the needs of connections they have not met the demands for keeping account of communications. This has not only been a source of great inconvenience, but also has lost the owners of the line a large proportion of toll receipts.

Knowing this, the Stromberg-Carlson Telephone Manufacturing company of Chicago, after considerable experimenting, has evolved a system that is supplying many of these wants. It consists of the company's already widely known telephone and its improved toll-line switchboard, a picture of which is given. The instruments on the lines can only call the central station, and no station can be called except with central station generator. This is thought to be a great advance in inde-

pendent telephony, and it also shows that the independent manufacturers can supply every need of the business.

Upton "Midget" Lamp.

In comparing the efficiency of enclosed arc with open arc lamps for service on street lighting and commercial circuits, the question of their respective candle powers is naturally an important consideration. While it is true that with an enclosed arc the candle power is lessened somewhat, actual experience is said to prove that this loss is more than counterbalanced by the gain in steadiness of light, equality of diffusion and absence of shadow in the use of an enclosed arc over an open arc lamp, and especially in the high-tension series lamp has this fact been developed. The open arc series lamp in feeding loses nearly its entire efficiency of light, and the feeding process takes place every five to ten minutes. The enclosed arc lamp feeds only once every four or five hours and the rise and drop in voltage is so slight and gradual as not to be noticeable.



WILLIAMS' BELTING.—FACTORIES AT DOVER.

The Upton "Midget" enclosed arc series lamp, shown on page 356, manufactured by the Standard Thermometer & Electric company of Peabody, Mass., is claimed to embody in its mechanism all that is best and most simple in the recent development of arc lamp construction. It is designed so that it can be easily adjusted to take from 65 to 80 volts, as may be desired, and burn on from 4½ to seven ampere circuits without readjustment. Each lamp is provided with a switch and an automatic cut-out which is positive in its action. These lamps are now in use on street lighting and commercial circuits, and the manufacturers claim to have flattering reports of their successful operation. Full information and circulars will be furnished on application.

Williams' Belting.

I. B. Williams & Sons, manufacturers of leather belting, Dover, N. H., started in business in 1842 and from a small beginning have kept pace with the increasing demands of the trade, until now they have one of the largest and most complete factories in the country, as may be judged by a glance at the accompanying cut, for the manufacture of leather belting, etc.

Their product is the result of an experience of over half a century and with a large force of skilled workmen and the most improved machinery, they turn out belting and lace leather of the finest quality in any quantity desired, with the greatest possible dispatch. They can fill all orders, no matter how large or small, promptly and satisfactorily. Not only has their reputation become firmly established in the manufacture of leather belting, but the superior qualities of their specialties have become widely known, their rawhide and tanned lace leather cannot be excelled, it is said, by any other manufactured.

Their special rawhide "Cocheco lace leather" is handsome, strong and pliable, and wears like buckskin, never getting hard. The color is a beautiful ivory white, made from the choicest hides in the market.

Another one of their specialties is electrical belting. They make a special belt which they brand their "dynamo." It is made from pure oak bark tanned centers taken from the choicest butts. These belts are specially adapted for their particular use and are warranted to give satisfaction wherever used. They are made throughout and on both sides from thoroughly stretched centers, and put together with the best adhesive cement, which insures a smoothness in running and pliability at the pulleys which cannot be obtained in a belt made in any other way. Prices and samples showing quality, finish and weight of stock used are furnished on application.

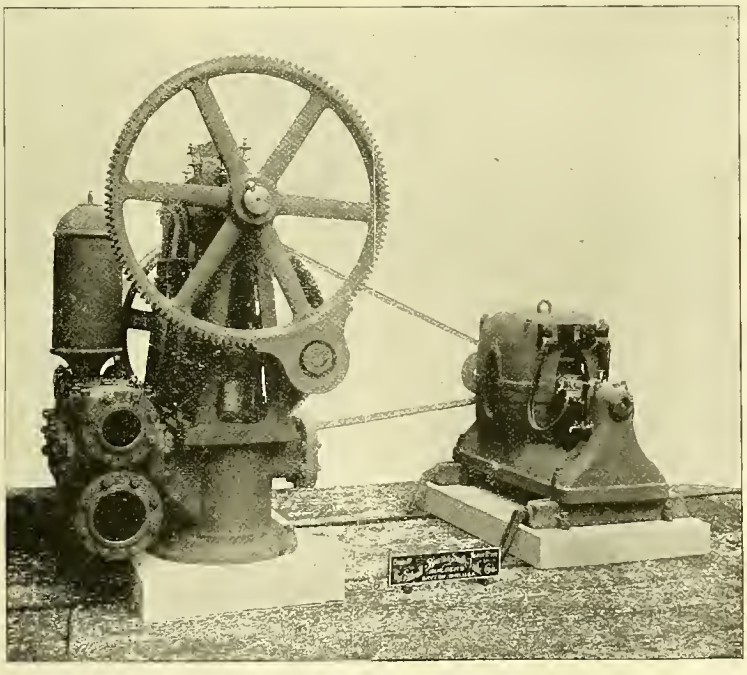


FIG. 2. TRIPLEX POWER PUMPS.

W. S. Porter has purchased the Electric Light company's system in Eldora, Iowa, for $22,500.

Triplex Power Pumps.

The problem of pumping water for towns and cities, filling tanks, hydraulic elevators, etc., at a minimum cost and maximum efficiency, is one that has taken up the attention of many eminent engineers; and the application of the gas engine and the electric motor in connection with power pumps has come into quite general use for this service. An improved type of vertical triplex power pump has been recently put on the market by the Stilwell-Bierce & Smith-Vaile company of Dayton, Ohio, and is shown in the cuts. These pumps are built on the principle that a continuous action of the plungers produces a constant flow of water and resultant high efficiency. They have three plungers connected to a three-throw crank-shaft, with the cranks set at an angular advance of 120 degrees; the crank-shaft is supported by four housings and bearings, forming a very rigid construction and perfectly balancing the strains, which in this type of pump are very unequal The plungers are provided with cross-heads and guides; the cross-heads have adjustable bronze shoes for taking up wear. The connecting rods have strap heads, brass boxes and taper-key adjustments. The pumps are made both single and double-acting. The double-acting pumps are provided with removable cylinders. The gears are machine cut; the counter-shaft, guides and connecting rod bearings are self-oiling, and the pumps are provided with an extra large valve area, which permits a high speed of piston travel. Ample room has been allowed for getting at the moving parts, to adjust the packing, etc., the idea throughout being to make this the most perfect machine of its type. The pumps are made in a number of sizes and weights adaptable to all kinds of service.

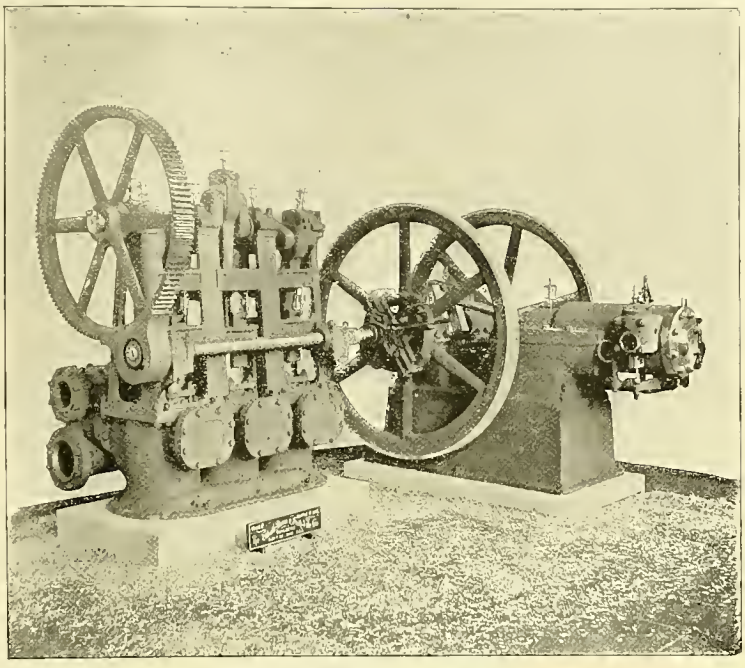


FIG. 1. TRIPLEX POWER PUMPS.

RESISTANCE MEASUREMENTS.

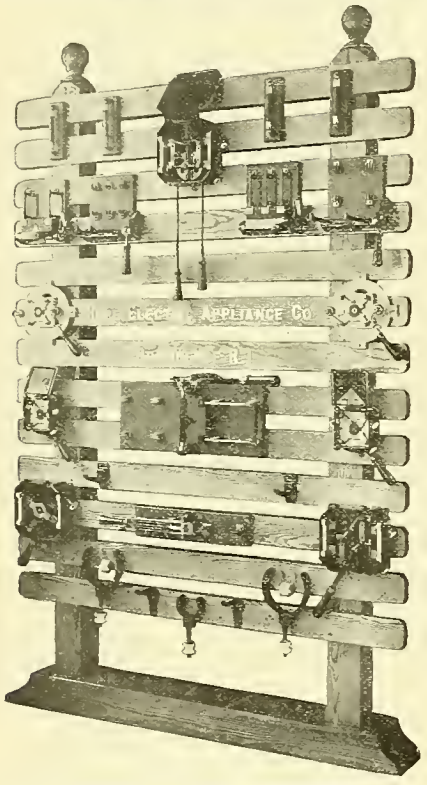
Fig. 1 shows the triplex pump directly connected to a gas engine. The engine is arranged with a friction clutch so that it can be thrown out or in. This makes a compact outfit and one that is easier to operate than a belted set. It is becoming a matter of great importance to railroad companies to handle water cheaply at their stations and they are largely considering this type of outfit. It allows them to dispense with the regular pumper and operate through their station man. The same pump belted to an electric motor for buildings and elevator purposes is represented in Fig. 2. These pumps are both horizontal and upright.

Resistance Measurements.

In electrical measuring instruments few are more important than the Wheatstone bridge, and this has come to be realized by the student, the engineer and the station manager to such an extent that to explain the advantages of this method of measuring resistances, or testing for broken circuits, short-circuits and grounds would be a waste of time and space. The main requirements of such apparatus are: First, that it should be portable, convenient and easy to operate and durable; second, that it should be accurate under all general conditions; third, it must have a wide range; fourth, it must be low in price.

About a year ago the Whitney Electrical Instrument company of Penacook, N. H., realizing that apparatus combining all of these conditions was not easily obtained, commenced a line of experiments; and in presenting the Whitney portable testing set (shown on page 357) this company offers the result of several months study and an instrument that has been thoroughly tried and in which every weak feature is said to have been eliminated. That all of these requirements have been met the following description of the instrument is thought to show:

In size it is 8 by 5 by 5½ inches and it weighs five pounds. It is guaranteed accurate to within one-fifth of one per cent., and with it resistances as low as one-tenth of an ohm can be measured. The rheostat arms are formed by the two outside bars and have a range of from one ohm up. The central bar comprises the two bridge arms, and by plugging or unplugging the ratio coils in these arms the value of the rheostat coils divided or multiplied as desired. The galvanometer is designed with especial reference to extreme sensitiveness and is



THE HOPE SLATTED SWITCHBOARD.

quick to respond with a small current, and in the measurement of low resistances one cell will be found ample.

These testing sets are made in two styles—with batteries for outside testing and where access to batteries is not convenient, and without batteries for school and laboratory work. The type containing batteries is furnished with six cells so arranged that from one cell up to the full battery can be used. The instrument is also provided with two binding-posts so that battery from an external source can be used if desired. The battery is of the chloride of silver type, and is especially selected for its permanency and efficiency. The cells will last several months in constant service, and may be renewed at a very small expense. The instrument is mounted in handsomely polished mahogany and all metal parts are substantially finished in lacquer. The resistance is of a special alloy, carefully made for the use of this company, and highly insulated. There is, therefore, no appreciable temperature error under general conditions. At the present time these sets are being made in a variety of ranges up to five megohms, and it is the intention of the manufacturer to build them with still greater capacity very soon.

The Hope Slatted Switchboard.

Among the most interesting exhibits at the recent Niagara convention of the National Electric Light association was the slatted switchboard now being manufactured by the Hope Electric Appliance company of Providence, R. I.

This switchboard, illustrated by the accompanying cut, is so simple that a brief mention is only necessary to reveal its most valuable features. The Hope company has all along been of the belief that every part, both back and front, of the modern switchboard should be exposed as far as possible to the eye of the switchboard tender. The cut shows that where instruments are mounted on a switchboard of the slatted character when an instrument shows trouble a short-circuit would instantly be revealed without the necessity of walking in behind the switchboard. This simple but valuable feature of the Hope board is one which, through its common sense, appealed to the many convention visitors that inspected it.

Standard Electric Company's Switches.

No electrical man, engineer or contractor, with the advances made in the use of high-tension circuits, needs to be told the importance of a reliable switch, releasing the contact blades quickly and positively. The day for hand-operated main-line knife switches seems to be passing. The Standard Electric company of Reading, Pa., has placed a line of switches on the market that is particularly adapted for controlling circuits, conveying high-tension currents, in which class of switches the breaking of the arc is the vital point. The cuts represent the single-pole switch open and closed. The features of the switch may be understood in this description: The circuit is broken by the release of the switch blades from engagement with the pole pieces by the expansive force of a compression spring, when the lever releases the cam. The switch lever or arm in its open position, it will be noticed, shows a wedge-shaped protrusion, which, when the lever is closed, engages itself with the rounded bearing faces of steel, which are permanently attached to the blades. This engagement by the wedge as an auxiliary makes the contact rigid and perfect in meeting the contacts on terminals. In a recent test for quickness in rupturing the arc a 15 ampere double-pole switch on an 80 light circuit of 220 volts opened the line with a barely perceptible arc.

Single-solenoid Enclosed Arc Lamp.

The existence of a demand for a short enclosed arc lamp for vestibules, hallways and restaurants and in places where the ceilings are low has invited the creation by the General Electric company of a single-solenoid lamp to meet it. This lamp is ornamental in appearance and measures only two feet in length over all. Its exterior appearance and interior mechanism are shown by the cuts. It is designed for use on 110 volt circuits, the potential at the arc being 80 volts. As in many cases for interior lighting a short ornamental lamp is desired not giving as strong an illumination as the standard five ampere lamps, this lamp is also built to burn at three amperes with three-eighths inch carbons and a carbon life of 75 hours.

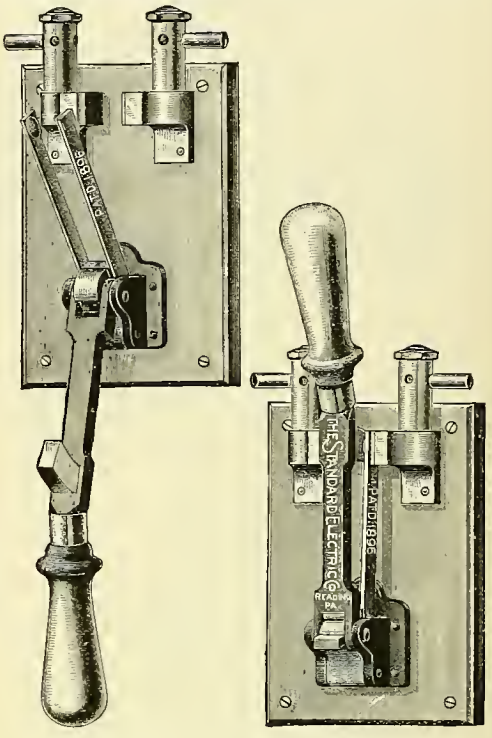
The lamp mechanism consists of one magnetic spool or solenoid which attracts through its center a tubular armature surrounding a brass tube through which the upper carbon is fed. To the lower end of the tube is attached a clutch which grips the carbon itself instead of the carbon rod. The upward pull of the solenoid is cushioned in two air dash-pots at the top of the tube. This gives a steady lift to the upper carbon, which can drop instantly when released.

The current is taken by the carbon from a brass tube with a contact device consisting of a series of flat springs pressing upon the interior of the tube. The contact device slides freely in the tube and gives perfect contact in all positions. When trimming the lamp the upper carbon is pushed up into a spring clip in the contact device, where it is held securely without set screw or clamp. The five ampere lamp has a carbon life of 100 hours and uses seven-sixteenth inch carbons. It is provided with three loops in the spool winding by means of which the lamp may be adapted to 4, 4½ or 5 amperes as desired. The five ampere lamp is similar in appearance to the three ampere lamp and can also be fitted with weatherproof casing for out-door service.

The Marcellus (N. Y.) Electric Railway company has been incorporated to operate a street railway two and a half miles long, from Camillus to Marcellus, Onondaga county. The capital stock is $60,000.

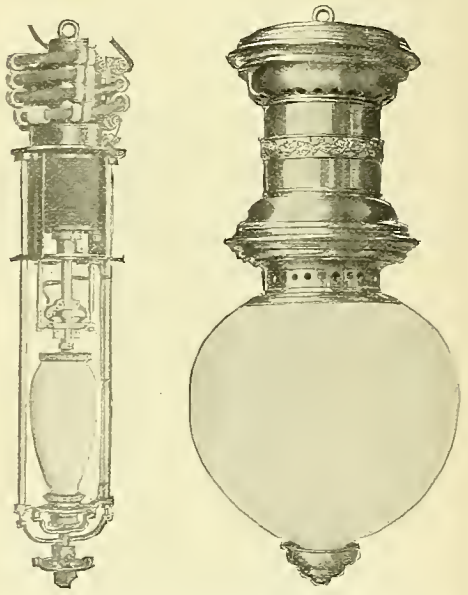
A New Chicago Electrical Ordinance.

At the Chicago Council meeting of June 8th, Alderman Miller introduced an ordinance to confer a franchise upon the Commonwealth Electric company for a period of 50 years for heating, lighting and power purposes. The proposed franchise covers the entire city. The company agrees to put the wires in conduits underground in the district bounded by the lake, North avenue to Wells street, Wells street to Lake, Lake to Ashland avenue, Ashland avenue to Sixteenth street. The company also agrees to have a plant costing $100,000 in



STANDARD ELECTRIC COMPANY'S SWITCHES.

operation in three years from the acceptance of the ordinance. The charge to private consumers will be one cent. an hour for each 16 candle power lamp and $10.50 a month for all night arc lights. For power purposes the company may charge 40 cents a horse power hour. Compensation is to be given the city at the rate of three per cent. per annum of the gross receipts after the plant has been established five years. The city may purchase the property after the expiration of the franchise. The bond required is $50,000. The ordinance was drawn by



SINGLE-SOLENOID ENCLOSED ARC LAMP.

W. K. Patterson, a lawyer, who says that moneyed men are behind the new electrical company and also behind the new Garden City Gas company, which is a sort of corporation twin. The scheme bears a great resemblance to the Ogden Gas and Cosmopolitan Electric franchises, and it is not known whether the projectors have any intention of going into the business of producing gas and electricity. The ordinances were referred to the committee on gas, oil and electric lights.

Canadian Electrical Association.

Held on the Canadian side of the river and a week ahead of the meeting of the National Electric Light association, the Niagara Falls convention of the Canadian Electrical association was likewise a notable gathering, with a large attendance of central station men.

The president, John Yule of Guelph, opened the convention by delivering an interesting address. He stated that the agitation in favor of municipal ownership was growing, and that some scheme would have to be devised to protect the electric lighting business. It should be shown to the government that it should provide for the compulsory transfer and purchase of properties in cases where the local authorities assumed control of the lighting service, and thus prevent invested money being wasted.

Mr. Yule referred in fitting words to the untimely death of the second vice-president, E. Carl Breithaupt of Berlin, Ont., who was killed by an explosion.

The secretary-treasurer's report showed an increase during the year of 42 active and two associate members; nine active and five associate resigned, and six active withdrawn, owing to removal. There were 33 active and 14 associate members struck off the roll for nonpayment of dues, and death had removed Messrs. Breithaupt and Congdon. The membership now stands at 154 active and 19 associate.

John Murphy of Ottawa read a paper on "Water Driven Plants," which was well received and upon which there was considerable discussion. Mr. Wickens of Toronto then read his paper entitled "The Steam End of an Electric Plant," and many practical points were brought out in the discussion.

At the invitation of the Buffalo & Niagara Falls Electric Railway company the visitors enjoyed a trip over the road to Buffalo, and there inspected the Buffalo power house, where the members of the association were given an opportunity of seeing what could be done in long-distance transmission of electric power.

On Thursday J. A. Kammerer read his paper on "Day Loads for Central Stations and How to Increase Them." J. J. Wright, Mr. Browne of Montreal and others participated in the discussion. Wm. Thompson of Montreal presented a paper entitled "Determination of the Heating Power and Steam Producing Value of Coals from a Preliminary Examination."

After the adjournment for dinner a visit was paid to the Niagara Falls Park & River railway power house.

Considerable discussion was evoked over the choice of a place to hold the next convention. Mr. Browne of Montreal vividly pictured the benefits to be derived from a visit to that city, and the association decided to hold the next convention there, the time to be left to the hands of the executive committee.

In the afternoon the following-named officers were elected: President, John Yule (re-elected by acclamation); first vice-president, C. B. Hunt; second vice-president, J. A. Kammerer; secretary-treasurer, C. H. Mortimer (re-elected by acclamation). The five members of the executive committee, who were re-elected, were J. J. Wright, F. C. Armstrong, John Carroll, A. B. Smith and O. Higman. The five new members of the executive committee, who were elected, were Messrs F. A. Bowman, W. H. Browne, Wm. Thompson, A. A. Dion and Wilfrid Phillips.

F. C. Armstrong read his paper entitled "Why Some Lighting Plants Do Not Pay." After the paper had been read a somewhat heated discussion followed as to the respective merits of the flat rate and meter systems, each system having its champions. Mr. Browne of Montreal strongly upheld the meter system. Mr. Armstrong was in favor of the meter system, but the difficulty in connection with small central stations, under the meter system, was to get a return for the outlay. Mr. Noxon of Ingersoll spoke in favor of the flat rate system; he said a yearly contract could thus be more easily obtained and the managers of stations were enabled to estimate their revenue. Mr. Pepler of Barrie said that the trouble with the flat rate system was with regard to the load, as the consumption could not be checked. He stated that they now had a sort of combined plan, that of using the meter system with large consumers and a flat rate with small customers and giving a reduction to large users. The majority of the members seemed in favor of the meter system.

C. A. Carr, manager of the London Electric railway, told, in an interesting paper, "How Electric Railways Might Be Made a Commercial Success." W. A. Johnson of Toronto read a paper entitled "Accumulators—Their Application to Central Station Lighting and Power," which elicited some discussion. D. H. Keeley's paper entitled "Economy in Circuits" was then presented.

In the evening the annual banquet was held at the Dufferin cafe. After the dinner had been served the following toasts were given: "The Queen," "Our Guests," "Electrical Interests," "The Ladies", and "The Press." The banquet was brought to a close by the singing of the national aothem, and was declared by all present to have been a decided success. The committee to which was due the success of the banquet was composed of E. E. Cary, F. C. Armstrong, W. Phillips, C. B. Hunt and A. B. Smith.

Friday was devoted largely to sight-seeing. Trips were taken over the Niagara Falls Park & River railway and on the celebrated Gorge Electric railway, and a visit of inspection was paid to the Hydraulic power house. The Maid of the Mist took the members of the association to the foot of the cataract, after which visits were made to the power house and works of the Cataract Construction company and the various electro-chemical works.

Votes of thanks were passed to retiring officers, to authors of papers, to the press and to all those who had tendered courtesies, after which the convention adjourned to meet at Montreal in 1898.

Electrical Decorations in London.

An English electrical contemporary says: Electricians and electrical engineering firms are full with orders for illuminations to celebrate the diamond jubilee. One very imposing scheme of decoration has been ordered by the London & Northwestern Railway company for its offices in Parliament street and Bridge street, Westminster. The principal features of the facade, with the central dome surmounted by a jeweled crown, are now being wired by the same firm that undertook the illumination of the Great Wheel. The design also includes the letters "V. R." and a motto which introduces the initial letters of the official title of the company—"Longest, Noblest, Wisest Reign." In this installation alone 3,000 lamps will be needed. One firm is producing an eight-rayed star, with five eight candle power lamps attached to each arm. When the wheel is revolved the whole 40 lights merge into a quivering sheet of flame, the outer edges of which acquire the prismatic hues of the rainbow. A very small motor is needed to keep the star rotating. It will probably be seen on June 22d, on the facade of one of the great co-operative stores. Another device, which was employed with great effect at Paris during the fetes given in honor of the czar of Russia, is the screening of small electric lamps of 2½ candle power with balloons of various colors, made of celluloid, which is waterproof and semi-transparent. When these spheres, gently glowing with blue, red or white light, are hung in garlands, built up in pyramidal form, or are made to pick out the various portions of a Union Jack, the effect is decidedly novel. They are capable of producing bold designs, as each balloon is 7½ inches in diameter. Lamps are also screened in letters composed of cut crystal; but perhaps the prettiest mode is presented by floral designs, the glass shades representing colored blossoms, and the foliage around them being of metal. An illuminated portrait of her majesty, with lamps bordering the frame, which has colored emblems, is another pattern. Coats of arms are similarly composed, with sometimes the addition of the dates 1837-1897, and the motto, "A Glorious Reign." But the simplest form of electrical device in the market is the imperial crown, which consists of a wire framework, with sockets for 75 lamps of eight candle power or 16 candle power. These lamps can be readily detached, and as they are of the ordinary pattern, may be used in the office or household after the diamond jubilee is over, so that the outlay is limited to the framework and the wiring. According to the *Daily Telegraph*, most of the central station companies have determined to make an inclusive charge of 3d. per lamp per night.

Mr. Friction's Evention.

[From the London *Electrical Engineer*.]

The "examination answer" is now usually regarded with suspicion. Unlike the atom (all apologies to the ghost of a very great physicist), it too often "bears the stamp of the manufactured article." But the following are genuine, as time and place are given. They occur, in fact, in the report of the results of the annual scholarship examinations, in connection with the Brighton and Preston School Board. Two are quoted as a sample. One candidate in magnetism and electricity, in answer to the question, "What is frictional electricity? Show that there are two kinds of electricity," says "Friction was a man who evented (*sic*) electricity. Volta also evented it, so they divided it into two sorts." This muddle up of half-remembered book knowledge is very terrible. Anyone, however, who has not forgotten his school-days, and really understands the mental processes of half-taught students, can see exactly how it came about. What is really terrible is to think of the proper way to answer the question. No doubt the boy was wanted to say in a roundabout and disguised way that frictional electricity was the electricity produced by friction—a way of explaining and describing things which is fatal to progress in science. And then he is to show that "there are two kinds of electricity." Now, Mr. Examiner, on your reputation as a member of a learned profession, are there? Answer number two, which is held up for scorn, is merely a case of a boy being stuffed with an illustration which he does not understand, but reproduces to the best of his ability. It is his misfortune that though he wrote it all by rote he did not write it right. The inspector complains "the few papers in mechanics were of very uneven merit. While there was one of peculiar excellence there was another equally distinguished in the opposite direction. The latter informs us that 'When a dog pursues a hare the dog's superior weight causes it to swing aside more. This is called inertia.' Then follows a diagram of inertia!" It does not by any means follow that the boys who gave these answers are dolts, though as a matter of fact there are grown-up people in the world who seem incapable of forming definite physical conceptions. But what does seem to follow is that a certain amount of what passes as science teaching has very little value.

Right to Remove Live Wires.

The Court of Appeals of Kansas (Northern Department) handed down a decision April 30, 1897, in the appeal case of the Leavenworth Coal company against Ratchford. This was an action in which the company named was sued for damages for injuries alleged to have been caused by Ratchford, who was the plaintiff coming in contact with a broken electric light wire, used by the company in operating its electric light plant in the city of Leavenworth. The court affirms a judgment against the company. It holds that proof that a live electric wire belonging to the electric light plant was broken and lying upon the premises of Ratchford, in such a condition as to endanger his property, and that in attempting to remove such wire injury resulted to him therefrom, made a *prima facie* case of negligence against the company, entitling the plaintiff to recover for such damage. In such a case, it says, the plaintiff had the right to attempt to remove the live wire from his premises, using ordinary care, and such attempt to remove the live wire was not in itself contributory negligence. It further holds that it was the duty of the company using the streets and alleys of the city with its poles and overhead wires in lighting the city and houses therein, to employ a sufficient number of men, and to use the best devices known for the purpose preventing injury to the inhabitants of the city by the displacement or breaking of its wires, and especially so immediately after a storm likely to produce such displacement or breakage. Again, the fact that the live wire was emitting sparks and a blaze of electric light, apparently jeoparding the buildings of the plaintiff, the court insists, would not of itself preclude him from attempting, using ordinary prudence, to remove such wire for the purpose of relieving his property from apparent danger of a conflagration; and such an attempt made by the plaintiff would not be held, as a matter of law, to be contributory negligence. The plaintiff having discovered that a broken wire of the defendent, emitting a blaze of electric fire apparently endangering his property, and in attempting to remove the wire from his buildings apparently jeoparded thereby, using for that purpose a base-ball bat, and being injured by coming in contact with the wire by an unexpected movement of the wire caused by its being thrown from such buildings by the use of such bat, such injury the court holds, was the proximate result of the negligence of the defendant company in permitting its wire to be broken and displaced and to fall upon the plaintiff's buildings.

Western Union Finances.

The Western Union Telegraph company has declared a quarterly dividend of 1¼ per cent., payable July 15th. The company reports for the quarter ending June 30th, the figures for 1896 being actual, while those for 1897 are partially estimated:

	1897.	1896.	Changes.
Net revenues	$1,550,000	$1,400,200	Inc. $149,800
Interest and sinking fund*.	203,875	203,504	Inc. 371
Balance	$1,346,125	$1,196 696	Inc. $149,429
Dividend	1,216,975	1.191.959	Inc. 25,016
Surplus	$ 129,150	$ 4,737	Inc. $124,413
Previous surplus	7,559.748	7,638,957	Dec. 79.209
Total surplus	$7,688,898	$7,643,694	Inc. $ 45,204

*Less $40,000, being portion of sinking fund for the bonds of 1900 returned to the company by the sinking fund trustees because the drawn bonds were not presented for redemption.

The increase of $25,000 in the amount required for the payment of the dividend for the current quarter is caused by the sale of 20,000 shares of the unissued balance of 46,300 shares of the increase in the capital stock, authorized by the stockholders on October 12, 1892. The June quarter completes the fiscal year of the company. Appended are the results for the year

ending June 30th, figures for 1897 being partially estimated, while actual figures are given for 1896:

	1897	1896	Changes.
Net revenues	$5,772,520	$5,897,980	Dec. $125,460
Interest and sinking fund.	934,455	933,957	Inc. 498
Balance	$4,838,065	$4,964,023	Dec. $125,958
Dividends	4,792,862	4,767,805	Inc. 25,057
Surplus	$ 45,203	$ 196,218	Dec. $151,015
Previous surplus	7,643,694	$7,447,476	Inc. 196,218
Total surplus	$7,688,897	$7,643,694	Inc. $ 45,203

CORRESPONDENCE.

New York Notes.

NEW YORK, June 12.—By its decision in the cases of Cliost and Beekman against the Third Avenue Railroad company of New York, the Court of Appeals has disposed of several questions of great importance, practically making void the Kingsbridge extension of the Third Avenue railroad, upon which the company claims to have spent $2,000,000. The court holds that an attempt to build a railroad on a public highway without authority is a nuisance, and that the city of New York has no inherent right, independent of legislative permission, to grant a franchise for constructing and maintaining a railroad in the public streets, and therefore no sale of a franchise can be valid unless it was proceeded with in the manner prescribed by the Legislature. One of the directors of the Third Avenue company said to a reporter that some plan for defending the rights of the company in the Kingsbridge road would be formulated. "We will have to turn in another direction," he said, "now that the court from which there is no appeal has blocked one path. As the franchise already granted to the company has been declared to be invalid, we may begin anew and seek another franchise for the road to Kingsbridge on the same line. It seems curious that the franchise should be declared to be invalid because the company paid $250,000 to the city." There was a fall of six points in the stock of the Third Avenue Railroad company on the Stock Exchange after the decision of the Court of Appeals that the franchise for the Kingsbridge extension was invalid.

This item was printed in one of the daily papers of Wednesday: A number of New England men have been at the Hotel Imperial for a day or two, looking after telegraph and telephone interests. They held a short meeting yesterday morning. The business transacted was not made public, but it is said to have been connected with the affairs of the Standard Telegraph & Telephone company and the Southwestern Telegraph & Telephone company. Those present included H. A. Whiting of Wilton, N. H., David S. Greenough and Charles S. Tuckerman of Boston and George B. Perham, C. J Glidden, C. E. Adams, J. W. Pickering and Levi Sprague of Lowell.

Counsel appeared before Justice Dickey of Brooklyn on Tuesday afternoon, in support of a motion by the Amsterdam Electric Light, Heat & Power company as assignee of the State Electric Light & Power company, to compel the commissioner of city works to grant it a permit to lay conduits in the streets of the city, and to fix and determine the depth at which the conduits should be laid. The motion was opposed by Corporation Counsel Burr, on the ground that as the resolution of the Common Council did not become a law until after a sum of $500 was due from the company, and as the money was not paid, the rights of the company under the franchise became void and the application should be denied. Decision was reserved. Justice Dickey remarked of Brooklyn in the course of the argument: "So far as electric lights are concerned this city is far behind many of the smaller villages." M. S.

New England News.

BOSTON, Mass., June 12.—The newspaper dispatches that gave the details, rather meager to be sure, of the recent meeting and organization of the anti-Bell interests of the West in Chicago, were read with a great deal of interest in New England, and more particularly in Massachusetts. During the present session of the Massachusetts Legislature there have been two attempts to secure legislation adverse to the Bell company. One of these came before the General Court in the shape of a bill for the investigation of the rates of charges made by the telephone companies by a special commission to be appointed by the governor, put in by a member from Holyoke, in the central part of the state, and the other bill, providing for substantially the same legislation, was fathered by a Boston member. Both bills were referred by the House to the next General Court in accordance with the report of the committee on mercantile affairs. This action was not taken, however, until the question of telephone charges was pretty thoroughly discussed. A third bill which was before the Legislature, and which was evidently framed in the interest of the smaller companies, and which provided that one telephone company could use the poles and wires of another company by paying a rental to be fixed by a state commission, was also defeated, but there is no doubt that the time is ripe in this section for action similar to that taken in Chicago. Press dispatches from New York state that the headquarters of the independent exchanges in New England are to be in Boston, but nothing definite is known yet of the plans of those most interested.

The celebrated third-rail system of the New York, New Haven & Hartford Railroad company, which was so successfully operated from East Weymouth along Nantasket shore last season, is to be pictured at Keith's theater in this city by means of the biograph. Arrangements have been made to secure a set of views, and the big motor cars and trailers used exclusively on this branch of the Consolidated will be shown going at top-notch speed.

An electric line is to be built from Rainbow, Conn., to Springfield, Mass. C. S. G.

PERSONAL.

A. C. Shaw of the *Electrical Engineer*, New York, was in Chicago early in the week.

Wardell Jukes, formerly with the United Electric Improvement company of Philadelphia, will hereafter represent the Shelby Electric company in that city.

Ferdinand M. Thieriot, who replaced William Mertens on the board of directors of the International Bell Telephone company, was the only new member elected at the annual meeting held last week.

President C. C. Warren of the Warren Electric Manufacturing company of Sandusky, O., visited Chicago last week. Mr. Warren is much pleased with the healthy growth of the business of his new enterprise. The Warren alternator has already been ordered from foreign countries.

Dr. A. Ozea, well known to the gallery exhibitors in the electricity building at the World's Fair, is dead. In endeavoring to subdue a refractory stallion at his stock farm at Palatine, Ill., on June 7th, he was kicked in the left side by the enraged animal, and the injury was so serious that he died a few hours later.

B. J. Arnold of Chicago, James I. Ayer of Boston and Gano S. Dunn of Ampere, N. J., have agreed at the request of *Electricity* to serve as a commission to investigate the correspondence plan of education and to report on the methods and courses of schools offering technical instruction of this character.

"Ten years ago," says the *Philadelphia Record*, "John J. Boyle was a Western Union telegraph boy." He is now in Europe, the proud winner of the Academy of the Fine Arts' traveling scholarship, with $800 prize money in his pocket. Young Boyle is an interesting example of the ambition of Young America. He was born on May 30, 1874, and came to Philadelphia when he was 12 years old, locating in Germantown. He sought employment in the mills, and subsequently became a messenger boy connected with the Chelten avenue office of the Western Union company. Later he attended the Daniel L. Keyser school, and took a night course at the Spring Garden Institute, being graduated with the highest honors.

Edward J. Nally, assistant general superintendent of the Postal Telegraph-cable company of Chicago, and Miss Lee Warren Redd, daughter of Capt. Oliver T. Redd of Lexington, Ky., were married at the home of Miss Redd on June 10th. Several Chicago friends of Mr. Nally accompanied him and witnessed the ceremony. Among those who were present were Guy E. Paine, superintendent of the Postal Telegraph company at Kansas City, who for several years was manager of the Postal company in Chicago; C. M. Baker, superintendent of construction, Chicago; F. J. Loesch; H. L. Childress, superintendent at Birmingham, Ala.; W. J. Capin, superintendent at Cincinnati; Graoville Howard, superintendent long-distance telephone, St. Louis; Edward W. Hardin and Frank J. Carlisle of Chicago, and William E. O'Neil of Chicago, who acted as best man. The employes of the Postal company remembered Mr. Nally and showed their devotion to him by sending him a beautiful reminder in the form of a silver service of 83 pieces. Many congratulatory messages were received. Mr. and Mrs. Nally are now enjoying their wedding journey, which will include a month's trip through Europe. On their return they will take up their residence at the Virginia Hotel, Chicago.

ELECTRIC LIGHTING.

In the sundry civil bill reported to the Senate there is appropriated the sum of $65,000 for an electric light plant in the new postoffice building in Washington, D. C.

A correspondent of the WESTERN ELECTRICIAN at Coshocton, Ohio, writes: "We have a lively and growing town of 6,000 people, three railroads, two telephone companies, two telegraph companies, long-distance telephone, waterworks, gas and arc light company, etc., but no incandescent system, and one is needed. Perhaps you have some friends who would like to know this. Coal can be had almost for the hauling."

The plans and specifications for the proposed water and electric light works in Martin, Tenn., are nearly completed, and the city will shortly advertise for bids. Each part of the material will be separately bid on. The mayor is J. E. Kennedy.

The leading illustrated article in the London *Electrical Review* of May 28th is a description of "The Edison Electric Illuminating Company of New York," by Harold Lomas and Herbert C. Gunton. An account of the Duane street switchboard, written by Mr. Van Vleck, is the principal feature.

The city of McKinney, Tex., is in the market for a 100 light dynamo, with lamps, sockets and 4,000 feet of wire, together with all necessary appliances and attachments to make a complete light plant. The apparatus is to be delivered free on board at McKinney, and the cash will be paid after trial and acceptance. T. T. Emerson is the chairman of the water works committee.

ELECTRIC RAILWAYS.

The first trolley car ran through the completed part of the Boston sub-way on May 15th, to test the roadbed and the rails. The trip was uneventful, everything being in excellent working order. A force of over 200 men is now employed in laying tracks and making electrical connections.

It is reported that the city authorities of Glasgow have decided to equip the Springburn street railway route with electrical power, the overhead trolley system being used. During the various discussions on the repeated recommendations of the tramway committee the trolley system was most strenuously opposed, but it now appears that a great deal of this feeling has been overcome, and this section will be equipped at a cost of something like £9,000, as an experiment in the first instance.

The State Department is in receipt of information from United States Consul Miller, at Hull, England, to the effect that plans and specifications are now being prepared for building and equipping ten miles of double track railway in Hull, on which the overhead electrical system will be used. Everything throughout the work will be new material. Bids for the work will be called for in about two months, and information relative to this work can be obtained by addressing A. E. White, borough engineer, Hull, England.

The Toronto Street Railway company celebrated the queen's jubilee by putting on the road 20 handsome open cars, to be known as "the jubilee set." Each car is 27 feet long and seven feet six inches wide, six feet longer than the present open cars. The extra length will allow a space of four inches more between the seats, adding greatly to the passengers' comfort. The cars are painted white and gold, carry bicycle racks on the back, and have double steps at the sides. The latest style of motor made by the Canadian General Electric company is used, and each car will seat 70 passengers. Manager Wanklyn and Superintendent Gunn maintain that the cars of the "jubilee set" are the finest on the continent.

It is perhaps not generally known, even in Brooklyn, that persons of respectable appearance may travel on the street cars of that city when they have no money. The New York *Sun* declares, however, that a woman who has left her purse at home, or a man who has spent all his change speculating in stocks, if ordinarily well dressed, has only to tell the conductor the condition of affairs on boarding a car, to get carried to any desired point. The conductor gives the penniless passenger an envelope addressed to the office of the company, in which to forward later the lacking nickel. This is done as a matter of course, and only a passenger who looks disreputable meets with refusal. The system has been in operation some time, which is apparent proof that the passengers who thus get trusted for their fares use the envelopes given them for the purpose for which they are intended.

TELEPHONE.

L. B. Eagle of Nelsonville, Athens county, Ohio, has been granted a franchise to establish a telephone exchange in that place.

Long-distance business by local exchanges in Virginia seems to be an established institution. It is stated that a long-distance telephone line is being constructed from Lexington to Buena Vista to connect at the latter point with a line to be built from Lynchburg. It is now learned that work on the line from Lynchburg to Buena Vista is being rapidly pushed, the route followed being along the old Amherst turnpike. When the connection from Lynchburg to Buena Vista is made, people of that city will be in telephone communication with cities and towns throughout the valley of Virginia.

Roanoke is at present having a telephone rate war. The Southern Bell company had control of the business for a number of years and charged the people $40 and $30 respectively for business houses and residences. A few months ago a committee of citizens waited on the representatives of the Bell company and requested that a reduction of rates be made. The Bell people asserted that the service could not be furnished for less than the prices charged, refusing to grant a reduction. The citi-

zens formed an independent company, but this was absorbed by the Interstate Telegraph & Telephone company of Durham, N. C. The concern reduced the prices to $30 and $20 and secured over 200 subscribers on five-year contracts. The new company has been at work for six weeks erecting poles and stringing wires. The Bell company is determined to keep up the war, and has already announced a reduction of 33⅓ per cent. below the rates of the new company.

TELEGRAPH.

The following-named directors were elected for the ensuing year at the annual meeting of the shareholders of the Mexican Telegraph company: John E. Alexander, J. Pierpont Morgan, Edmund L. Baylies, Percy R. Pyne, William Gaston Hamilton, W. Emelen Roosevelt, Charles H. Marshall, James A. Scrymser and George G. Williams.

At the annual meeting of the shareholders of the Central & South American Telegraph company recently the following-named directors were elected for the ensuing year: Edward D. Adams, Charles Lanier, George S. P. Bowdoin, J. Pierpont Morgan, W. R. Grace, T. Jefferson Coolidge, William Gaston Hamilton, James Alfred Roosevelt and James A. Scrymser.

MISCELLANEOUS.

The War Department is inviting sealed proposals until July 6th, for furnishing and delivering at Willetts Point, N. Y., 30 miles single and nine miles seven-cored cable. Information will be furnished upon application to Major John G. D. Knight, Willetts Point, N. Y.

Sealed proposals are invited until June 22d for furnishing the Boston Navy Yard with a quantity of electrical supplies, etc. Blank proposals will be furnished upon application to the navy pay office, Boston, Mass. Proposals are being invited until June 25th for furnishing the Sandy Hook proving ground with electrical material and supplies during the fiscal year ending June 30, 1898. Information furnished on application to Captain Frank Heath, Ordnance Department, Governors Island, N. Y.

United States Consul Monoghan at Chemnitz, Germany, has informed the State Department that a new invention, known as iron felt, has just been brought out in Berlin and Leipsic. It is made from the best woolen materials impregnated with the inventor's patented preparation, which gives it great toughness and resistance. The article is most useful for railroads of all kinds. Placed between the rails and ties it deadens sound, prevents shocks, and consequently lessens the wear and tear on the road. The first experiments with the new material were made on the Berlin street railway, over which 360 trains pass daily. The results surpassed the most sanguine expectations, and persons living on the line of the road were delighted. Not only was the noise reduced to a minimum, but the wear and tear is materially diminished; hence the cost of running the road is greatly reduced. This material is to be tried on the new roads that are now being constructed in Leipsic. Old buildings, and buildings of iron and stone suffer most from the shocks and noise of passing trains, and where these are, such a material is valuable. The consul says that the material seems to be especially adapted for elevated roads.

TECHNICAL SCHOOLS.

As shown by the catalogue of the University of Wisconsin for 1896-97, there are 82 students in Prof. Jackson's electrical engineering department, 218 in the College of Mechanics and Engineering and 1,650 in the whole university. The school year of 1897-98 opens on September 29th.

The Year Book of the Society of Engineers of the University of Minnesota for 1897 is out. It contains three articles on electrical topics by Prof. Shepardson. The announcement of the College of Engineering and the Mechanic Arts for 1897-98 is issued in pamphlet form and gives all needful information.

The 1897 catalogue of the University of Minnesota contains over 300 pages and embraces all necessary information about the institution. In the college of Engineering, Metallurgy and the Mechanic Arts there are 181 students, and of these 62 are enrolled in the electrical engineering section under Prof. George D. Shepardson. In the graduate department there are two candidates for the degree of electrical engineer.

In this year's graduating class of the Massachusetts Institute of Technology there are 176 men who received the degree of bachelor of science and four upon which the master's degree was conferred. The number of graduates in each department was as follows: Mechanical engineering, 40; electrical engineering, 33; civil engineering 25; chemistry, 17; architecture, 16 chemical engineering, 12; naval architecture, 9; general studies, 7; mining engineering, 7; sanitary engineering, 4; physics, 3; biology, 2; geology, 1.

TRADE NEWS.

The firm of Clymer & Heilman, manufacturing electricians, Reading, Pa., has dissolved partnership by mutual consent. Mr. Clymer has interests in East Saginaw, Mich., requiring his attention, and Mr. Heilman, the practical member, has accepted a position as superintendent of the Standard Electric company's factory.

Fred F. Fischer, designer of the Fischer, Fischer-Gates and Gates' automatic engines, and until recently chief engineer and head salesman of the steam department of the Gates Iron Works, has withdrawn from this company, and will probably place upon the market "the improved Fischer engine," which it is intended shall embody the experience gained in designing and operating the above-named engines.

The old reliable P & B products of the Standard Paint company of New York continue to meet approval. "In the last six months," says Mr. DeRonde, "the increase of sales on our insulating compound and other electrical goods, particularly in the West, has been most gratifying. We find people who used our goods 10 years ago are using them to-day, preferring not to change for some unknown and untried material claimed to be the best but without anything to prove this bold assertion except the printed testimonials of the manufacturers themselves. We are now making a specialty of tape for re-insulating cable, preservative paints for poles, and cross-arms, acid-proof paints for battery rooms, etc. We are also offering a most excellent white and color water paint which is especially adapted for use on walls, etc. Color card and price list of this material will gladly be sent anywhere on application."

BUSINESS.

The Walker company has made a notable success with its electric railway apparatus, and can point to many successful and efficient plants. Circular No. 1,038 shows the points of excellence claimed for the generators and gives details of construction.

The Highland electric soldering paste is meeting with great favor as a soldering flux which seems to possess every advantage and none of the disadvantages of the other kinds on the market. It is put up in convenient form for use, and certainly makes a successful joint. The Electric Appliance company of Chicago, which handles this soldering paste in the West, is sending out small sample boxes, and states that the samples distributed have already resulted in the sale of several hundred pounds of the soldering paste, and that every customer is highly pleased with the work done with this flux.

Among the advantages claimed for the O. K dry battery by the Non-Polarizing Dry Battery company of 347 West Broadway, New York, are these: Polarization reduced to a minimum (therefore will give a continuous and steady output of current until exhausted); free from all local action (therefore will not deteriorate while idle); great recuperative power; compactness, being smaller than any other type of cell of equal capacity; remarkably high voltage and amperage; unaffected by heat or cold; its gases find means of escape (therefore cannot bulge and will not burst under short-circuit). This battery is in use by the leading railroad companies for signal towers and grade-crossing signal bells and also by leading gas-engine builders.

The Nungesser Electric Battery company, Cleveland, Ohio, has been recently reorganized, and with increased capital will hereafter conduct an active business in its special line of primary batteries. The company will produce batteries in various forms, such as dry, closed-circuit batteries and chloride of silver batteries, and it claims many new features in its goods that heretofore have been unattained in primary batteries. Its closed-circuit batteries are said to be of high efficiency for fan-motor work, gas engine ignition and other heavy open or closed circuit service. Its sealed portable chloride of silver batteries are in demand, both in this country and in England, by the manufacturers of motor wagons and others desiring light weight and small size and where constant potential is essential.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 8, 1897.

583,900. Electric Meter. Jesse Harris, Lynn, Mass. Application filed November 25, 1895.

In this meter an integrator and a motor arranged to operate the same are combined with means for stopping and starting the motor, together with an electric dynamometer operatively connected with the stopping and starting means, and an automatically operating device arranged to throw the motor into and out of circuit at predetermined speeds in order that the current may be controlled, the motor governed and the speed kept practically constant.

583,902. Rail Bond. Samuel H. Harrington, New York, N. Y., and George E. Somers, Bridgeport, Conn. Application filed March 19, 1897.

A rail bond having a shoulder near its end and a separate sleeve adapted to slip over this end and to bear against the shoulder, one end of the sleeve being diagonal of its axis.

583,903. Feed Wire Connection. Samuel H. Harrington, New York, N. Y., and George E. Somers, Bridgeport, Conn. Application filed April 8, 1897.

This device is intended primarily for use in trolley conduits, and consists substantially of a plug or ferrule adapted to be secured in a rail, and a plurality of flattened wires adapted to engage with a feed wire or cable.

583,912. Secondary or Storage Battery. Alvaro S. Krotz, Springfield, Ohio. Application filed March 27, 1894.

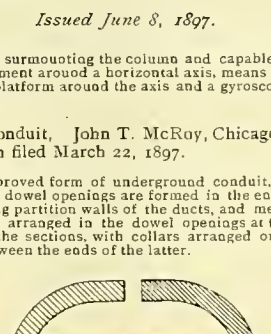
In this design the supporting plates are formed of insulating material, and have slotted openings with upturned edges; electrodes formed of active material are arranged between the upturned edges and between the slotted openings, the plates being arranged one above the other, with the slotted openings in one plate in line with the electrodes of the adjacent plates.

583,916. Searchlight Mount. Francis T. Marchand and George E. Marchand, Annapolis, Md. Application filed September 21, 1896.

The support consists of a column revoluble about its vertical axis, a stationary base supporting the column, a platform surmounting the column and capable of angular displacement around a horizontal axis, means for displacing the platform around the axis and a gyroscope controlling it.

583,926. Conduit. John T. McRoy, Chicago, Ill. Application filed March 22, 1897.

An improved form of underground conduit, with ducts, in which dowel openings are formed in the ends of the intersecting partition walls of the ducts, and metallic dowel pins are arranged in the dowel openings at the adjacent ends of the sections, with collars arranged on the dowel pins between the ends of the latter.



NO. 583,903.

583,933. Electric Motor. Edwin S. Pillsbury, St. Louis, Mo. Application filed November 16, 1895.

One claim is given: In an eletric motor, the combination with the armature, of open windings thereon, a commutator for said windings, brushes which are yieldingly held against the commutator, means for electrically connecting said brushes when they are relieved of pressure, a short-circuiting ring adapted to contact with the commutator segments, means for forcing said ring into and out of contact with the commutator segments, and at the same time relieve and restore the pressure on the brushes, and a handle for operating said mechanism.

583,934. Shunt Ammeter. William B. Potter, Schenectady, N. Y. Application filed January 25, 1897.

Two or more ammeters are connected in shunt to a common resistance.

583,935. Series Parallel Controller. William B. Potter and Frank E. Case, Schenectady, N. Y. Application October 10, 1896.

In a controller, the combination of a cylindrical switch, contacts thereon, and sets of stationary brushes engaging therewith, the brushes and contacts bearing such a relation to each other that the circuit is alternately completed or broken at one set, then at another.

583,936. Electric Furnace. Edgar F. Price, Niagara Falls, N. Y. Application filed September 23, 1896.

The combination with a furnace hearth forming one electrode, of a range of carbon electrodes and means for supporting the same above the hearth, a hopper surrounding the carbon electrodes with one end of the hopper directly above the delivery end of the hearth, the end carbon in the range of electrodes being closely adjacent to the hopper, so as to prevent material passing down between the carbon electrode and the hopper at the delivery end of the hearth.

583,944. Rotary Converter. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed March 14, 1896.

An armature for dynamo-electric apparatus of the alternating current type, comprising a winding and collecting rings, each collecting ring connected to leads equally spaced around the armature winding and connecting equipotential points of each phase to one of the collecting rings.

583,945. Electric Light for Vehicles. Alfred M. Rodriguez, Brooklyn, N. Y. Application filed October 7, 1896.

A friction wheel is mounted on the vehicle and in peripheral contact with some part of a wheel thereof, and there

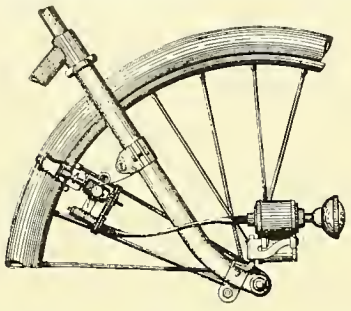
is a flexible shaft between the shaft of the friction wheel and the arbor of the armature of the generator and connecting the same, whereby the former drives the latter.

583,950. Three-phase Induction Meter. Charles P. Steinmetz, Schenectady, N. Y. Application filed January 30, 1897.

In this apparatus there is a closed-circuit armature and magnetizing coils comprising current coils in two of the main lines, and two potential coils or sets of coils in circuit with electromotive forces which are in quadrature with the electromotive forces between the third main and the two mains carrying current coils.

583,951. Motor Meter. Charles P. Steinmetz, Schenectady, N. Y. Application filed January 30, 1897.

An inductive device for obtaining a definite phase displacement between a circuit and a branch thereof, consisting of two windings having different numbers of turns inductively related upon a common core, the windings being included respectively in branches of the circuit.



NO. 583,945.

583,953 Apparatus for Producing Currents of High Frequency. Nikola Tesla, New York, N. Y. Application filed October 19, 1896.

The combination with a set of contacts, one of which is adapted for connection with one of the mains from a source of current, and each of which is connected to one of the terminals of a series of condensers, and a second set of contacts similarly connected to the opposite main and condenser terminals respectively, of electrically connected plates or segments upon which the contacts of the first set bear, similarly connected plates upon which the contacts of the second set bear, and isolated plates common to the two sets of contacts, the plates being arranged in the manner described, whereby the condensers will be alternately charged in multiple and discharged in series.

583,955. Carbon Holder for Arc Lamps. Elihu Thomson, Swampscott, Mass. Application filed October 31, 1896.

A carbon clamp for arc lamps, provided with an eccentrically pivoted rotary jaw fixable in a number of working positions, a horizontal sliding jaw, and means for clamping the same in a desired position.

583,956. Producing Stereoscopic Pictures by Röntgen Rays. Elihu Thomson, Swampscott, Mass. Application filed January 5, 1897.

This is described as the art of producing stereoscopic pictures by the use of Röntgen rays, which consists in exposing a photographic plate to the action of the rays with the object to be photographed and the source of Röntgen rays in a certain definite relation to the plate, and then removing the plate and exposing a second one with the source of Röntgen rays and the object to be photographed in a different position relative to the second plate, thus displacing the shadows upon the two plates by an amount sufficient to give a stereoscopic or solid effect when viewed through suitable lenses.

583,957. Electrostatic Influence Machine. Elihu Thomson, Swampscott, Mass. Application filed January 5, 1897.

In an electrostatic generator, a charging exciter plate provided with an equalizer, and a pair of sector-charging collectors connected to the sectors of the charging plate and the sectors of the working plates of the machine, the exciter having no connection with the working circuit.

583,963. Electric Switch. George Winckler, Schenectady, N. Y. Application filed June 4, 1896.

The combination of a base, terminals mounted on the base, a blade for closing the circuit between the terminals, a back or lever to which the blade is removably secured, and a handle for securing the blade to the back and operating the switch.

583,987. Lightning Arrester. Axel Ekström, Schenectady, N. Y. Application filed May 15, 1896.

A lightning arrester comprising a number of spark-gaps in series, of a kind to have their resistance decreased by use, combined with means controlled by such decrease in resistance for increasing the number of spark-gaps in series.

583,991. Binding Band for Armatures. Henry Geisenhöner, Schenectady, N. Y. Application filed October 31, 1896.

In a binding-band for armatures, the combination of a metal strip, loops formed at the extremities of the strip by bending the ends backward and securing them to the strip, a wedge secured to the strip, and clamps engaging with the wedges for drawing the extremities of the band together.

583,997. Turn-table for Surface Contact Electric Railways. Edward M. Hewlett, Schenectady, N. Y. Application filed November 18, 1896.

This invention is intended to provide means whereby a turn-table in a surface-contact electric railway can be operated so that the relation of the contacts on the turn-table and in the railway is invariably preserved.

584,009. Safety Plug. Thaddeus S. McClintock, Pittsburg, Pa. Application filed August 5, 1896.

In combination with a screw-threaded safety-plug externally recessed there is a conducting ring about the plug and in the recess, having bulged portions forming contact parts and a second contact piece on the plug, with a fuse connecting the same with the conducting ring, the plug being adapted to fit into a screw-threaded socket.

584,013. Rail Bond. William B. Potter, Schenectady, N. Y. Application filed December 18, 1896.

The combination of roughened plates, a conductor connecting the plates, a plastic compound of good conductivity filling the roughened portion of the plates, and means for securing the plates to the rails.

584,029. System of Electrical Distribution. Joseph L. Woodbridge, Brooklyn, N. Y. Application filed November 13, 1895.

The general arrangement comprehends the combination of bus bars, a feeder, a generator whose field magnets are provided with a winding that may be used as a shunt winding, and means for connecting the generator at pleasure either across the bus bars as a constant potential machine or in series between the terminal of the feeder and the bus bar of like polarity, and means for restoring the feeder to direct connection with the bus bar when the generator is connected across the bus bars.

584,050. Process of and Apparatus for Aging Alcoholic Liquids. Heinrich Deininger, Berlin, Germany. Application filed November 1, 1895. Patented in Belgium April 30, 1895.

One claim relates to a process for aging alcohol-containing liquids, which consists in first impregnating the liquid with oxygen and then subjecting it to the action of an alternating current of electricity.

584,056. Igniting Device. Bogulaw Jolles, Vienna, Austria-Hungary. Application filed February 1, 1897.

An electric gas-lighting device is described.

584,062. Synchronizing Mechanism. Horace F. Parshall, London, England. Application filed December 31, 1895.

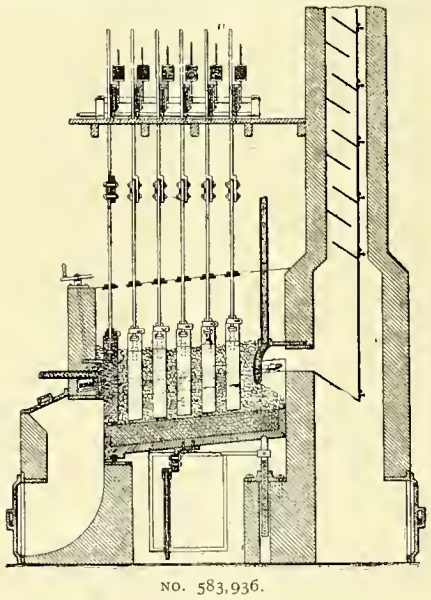
The art of maintaining synchronism of alternating generators separately operated in parallel by controlling the speeds of the different generators by means acting upon their prime movers and actuated by the variations of phase relation between the generators.

584,120. Art of Welding and Brazing. David W. Payne and Eugene Diven, Elmira, N. Y. Application filed October 26, 1896.

A plan of welding or brazing together flatwise metal pieces having different characteristics is described. One method consists in holding the pieces together at the seam or joint between two electrodes, passing an electric current from one electrode to the other across the joint, the electrodes being so arranged and constructed that the current passing through them is made to impart different degrees of heat to the two electrodes, whereby the metal pieces at the joint are made to attain their respective welding or brazing temperatures by conduction of heat from the electrodes. The pressure upon the pieces is maintained after the heating current is turned off and until the joint is sufficiently cooled.

584,149. Automatic Electric Time Switch. Leon H. Watters, Media, Pa. Application filed April 1, 1896.

In this electrically operated device there is a shaft with a spur-wheel thereon, having a cam connected therewith, the wheel having thereon the names of the days of the week, a pinion geared with the spur-wheel, a minute-hand with a post having a cam thereon, and a lever operated by the latter cam and working the first-mentioned cam on the spur wheel.



NO. 583,936.

584,155. Electric Regulator. Christopher C. Gartland, Buffalo, N. Y. Application filed September 4, 1896.

In an electric regulator for dynamo-electric machines, the combination of a rheostat, a connecting arm arranged to vary the resistance thereof, an arm connected to the brush-rocker of the dynamo, ratchets actuating the arms, oppositely acting pawls adapted to engage the ratchets and move the same in either direction, a rocking lever engaging the pawls and adapted to move the same in or out of engagement with the ratchet, and an electro-magnet having its armature connected to one arm of the lever.

584,173. Hotel Electric Call Apparatus. Albert B. Chance, Centralia, Mo. Application filed November 23, 1896.

A hotel annunciator having an electrically connected clock and a telephone cabinet.

584,184. Electric Arc Lamp. Gilbert L. Moyer, Hartford, Conn. Application filed October 22, 1896.

An arc lamp with a magnet connected with the circuit wires, an armature for the magnet, a piston connected with the armature and movable in a cylinder, a clutch connected with the armature and adapted to engage with and move the upper carbon rod, and a piston connected with the clutch and movable in a cylinder is described.

584,185. Cut-out Switch. Gilbert L. Moyer, Hartford, Conn. Application filed November 18, 1896.

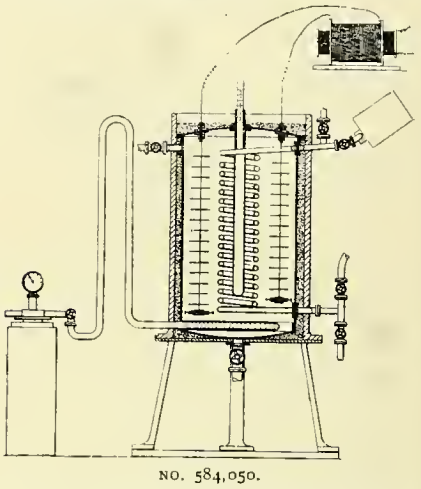
Features described are an insulating base bearing stationary and movable poles, a handle adapted to operate the movable poles, posts connected with the stationary poles; a cap fitted upon the base, contacts borne by the cap engaging with the posts, and fuse wire connecting the contacts and extending around the edge of the cap.

584,186. Electric Arc Lamp. Gilbert L. Moyer, Hartford, Coon. Application filed January 20, 1897.

In this lamp there is, in combination with the arc-striking mechanism, a feed clutch, a feed tube engaged by the clutch, and a feed rod connected at one end with the feed tube, and at the opposite end with a carbon holder.

584,202. Burglar Alarm System. William T. Arnold, Chicago, Ill. Application filed December 15, 1896.

In this arrangement an effort is made to conceal the identity of the line conductors.



NO. 584,050.

584,235. Insulator for Telegraph or Other Electric Wires. Christopher C. Nesmith and George F. Arnett, Manchester, Ala. Application filed March 27, 1897.

An insulator for electric wires consisting of two separable parts having contact faces which are provided with one or more curves and a channel in one of the faces for the wire, a bracket having a recess to receive the insulator provided with an aperture to receive a lug upon one of the parts of the insulator, and a set-screw tapped into the bracket and entering the recess to bear against the other part.

584,249. Thermostat. Henry Van Hoevenbergh, New York, N. Y. Application filed January 16, 1895.

A thermostat comprising a slender metallic rod or wire extending through a non-conducting casing closely embracing it, the conductor being fixed at one end and co-operating with a detent at the other, means for closing an electric circuit through the wire to expand the wire, and thereby exert a positive thrust against the detent, and a circuit closer controlled by the detent.

584,258. Prepayment Mechanism for Electrical or Other Meters. Charles O. Bastian and Herbert C. Hodges, London, England. Application filed August 17, 1896.

In a coin-freed prepayment meter, the combination with a movable bar adapted to be operated by an exterior handle on the insertion of the proper coin or token, of means interposed in the path of travel of the bar or some projecting part thereon, and adapted to be operated by the latter to permit the supply through the meter, and means also interposed in the path of travel of the bar or projecting part thereon to rotate in one direction an axis in connection with the meter-operated mechanism, and rotated in the opposite direction by the movement of the latter, and means carried on or operated by the axis to close a local electrical circuit when the axis has returned to its normal position, and thereby cut off further flow through the meter until a fresh coin or token has been inserted.

585,297. Non-interfering Signal Box. John T. Stack, Chicago, Ill. Application filed September 29, 1890.

The first claim reads: In a signaling apparatus, a number-wheel and a second wheel controlling a short-circuit around the said number-wheel, the said second wheel being provided with notches which correspond in number and arrangement to the signaling elements of the said number-wheel, in combination with a lever having a pin or projection adapted to move in one direction through the said notches, but which cannot normally move through the same in the reverse direction, and a catch or guide which forces the said pin through in the reverse direction at a predetermined point in the wheel's revolution, thus breaking the short circuit, and an extra notch into which the said pin can pass, but not far enough to restore the short-circuit.

584,299. Connection for Electrical Conductors. Bernard F. Weldon, Pittsburg, Pa. Application filed May 5, 1897.

A connection for electrical conductors or wires, comprising an inclosing envelope surrounding the wires, and bent transversely.

584,309. Apparatus for Securing Funds of Banks Against Robbery. Phineas F. King, Chicago, Ill. Application filed December 31, 1896.

One claim describes the combination with a rotatable cash receptacle and sheathing box therefor, of a pedestal upon which the cash receptacle is mounted, an emergency lock for the cash receptacle disposed within the pedestal, means for obtaining access to the pedestal located at a point remote from the house or other place of business, mechanism for applying the emergency lock also disposed within the pedestal, and an electro-magnet or magnets adapted when energized to initiate the operation of the locking mechanism, whereby the emergency lock is applied together with an electric circuit or circuits, including a source of current supply leading to a point or points in the banking house or other place of business, relatively remote from the cash receptacle.

Western Electrician.

EVERY SATURDAY.

Vol. XX. CHICAGO, JUNE 26, 1897. No. 26

Edward B. Ellicott, City Electrician of Chicago.

The man who was appointed superintendent of city telegraphs of Chicago by Mayor Harrison last week, and who, having accepted, has thereby become the city electrician, succeeding John P. Barrett, is not a politician, in the ordinary acceptance of that term, although in political sympathy with the dominant party in the city hall, but he is a practical, experienced electrical man. Edward B. Ellicott, the new incumbent of the office, is a young man, but he has a record of 11 years' continuous service in electrical work, and from the unbroken success of his career and the appreciation of his work and character by those who are best qualified to judge, there seems to be no doubt that he is entirely capable of supervising the electrical work of the city of Chicago with honesty, technical ability and good judgment.

Mr. Ellicott is but little over 31 years of age. He was born in Batavia, N. Y., March 28, 1866, and is descended from a family prominent in the early history of Western New York. His grandfather and granduncle surveyed a large portion of the western end of the state, and Ellicott street and Ellicott square perpetuate the family name in Buffalo. As a boy and youth young Ellicott was given a high-school education in his native town, and from the academy he graduated to the printing-office, that practical finishing-school which has developed the ambition and talent of generations of bright American boys. Of the three years that the young man gave to the fascinating drudgery of the printer's apprentice, one was spent in the West, as he had gone out to Missouri some two years after leaving school.

From the period of that journey—about 1885—Mr. Ellicott has made his home in the West, and a change that took place in the succeeding year marked the beginning of his electrical career. In 1886, then, at the age of 20, the young man removed to Concordia, Kan., to become the bookkeeper for his cousin, H. M. Spalding. Mr. Spalding operated a flour-mill, and shortly after Ellicott entered his employment he put in a small electric light plant in connection with it, and placed his bookkeeper, who had a mechanical bent, in charge. This confidence was not misplaced. The ready-made superintendent was young and ambitious; he had a latent talent for practical electrical work, and this he zealously developed by study and hard, practical work. So well did he succeed that within a year he was tendered the position of chief engineer and electrician of the Salina Gas & Electric Light company, which at that time operated the largest plant in that part of Kansas. Mr. Ellicott accepted this place, which was a responsible one for so young a man, but within a year his cousin induced him to return to Concordia to superintend the plant in that town, and here he remained for two years, adding considerably to his fund of knowledge and experience.

In 1890 Mr. Ellicott took another important step. He came to Chicago and entered the service of the Western Electric company, with which he remained up to the time of his appointment by the mayor. At first he went out on the road installing plants, but after a year and a half of this he was made assistant superintendent of construction, and in 1893 he was promoted and became superintendent of construction. In a large electric manufacturing company like the Western Electric, this is a position of great responsibility, and it requires both executive and technical ability. Mr. Ellicott filled it for four years to the entire satisfaction of the general officers of the company. He installed all the plants, with one exception, sold by the company in that time, and the list includes a number of large and important installations throughout the country. In each case the superintendent of construction was responsible for the plant from the time the apparatus left the factory until the work was finally accepted by the purchaser.

The new city electrician has ingenuity and inventive ability as well as the constructive faculty. While with the Western Electric company he designed several improvements in switchboard detail, and he has been granted two patents—one for a voltmeter switch and another for automatic pneumatic theater rheostat control. In addition he has two patents pending. During the World's Fair period Mr. Ellicott devised the wiring of the Ferris Wheel, and, as it will be remembered, the electric lighting of this huge revolving structure was one of the most striking of the night effects of the exposition. Mr. Ellicott also designed and wired the miniature World's Fair which was exhibited at the Atlanta Exposition and afterward at Chester Park, Cincinnati. This model was executed on a scale that gave a facsimile of every building on the grounds, every lamp-post even, in a space of 57 by 43 feet. It gave a reproduction, greatly reduced, of course, of the electric lighting of the exhibition with a degree of exactness hardly to be expected. Not only were the buildings generally illuminated from within, but every lamp-pole on the grounds, properly placed, had its spark of light, and the effective cornice and outline lighting of the great buildings was simulated in tiny points of light and with remarkable fidelity to the original. Special appliances were designed for this miniature work, and much ingenuity and skill were shown in plan and construction. In lighting this model 1,400 miniature lamps were used in addition to about 2,000 pin-points of light on building exteriors.

EDWARD B. ELLICOTT.

Mr. Ellicott resides at the Union League club, of which he is, of course, a member. He is also on the membership rolls of the Ashland club, the Lincoln Park Yacht club and the Mercantile club of St. Louis. He is a Royal Arch Mason and a member of the order of Knights of Pythias. He also holds membership in the National Association of Stationary Engineers. In manner he is pleasant but decided, and he seems to possess sufficient decision of character to give a practical, straightforward administration of the office of which he is so soon to take charge.

Electrical Work in Philadelphia.

In the second annual message of Mayor Warwick of Philadelphia the full report, for the year 1896, of David R. Walker, the chief of the electrical bureau of the city government, is included. The mayor gives this summary of the work of the electrical bureau:

The electrical bureau is one of the best equipped bureaus of this character in this or in any other country. Our municipal electrical plant has attracted attention throughout the world. Its reputation has gone abroad, and strangers visiting this city who are interested in electrical matters make it a point to visit and investigate the plant. After careful and critical inspection it has received the approval and unqualified praise of some of the most scientific men of this and other countries.

The underground system has shown its usefulness, and should be continued until overhead wires are entirely removed from the streets.

This system for police and fire service extends throughout the center of the city, and is most effective in every way. We have, however, but 885 fire-alarm boxes, which the director, in his report, is compelled to say, after careful consideration, is totally inadequate, considering the area of the city. New York has over 2,500 such boxes, and I cannot too strongly urge that appropriations be made providing for the extension of this system in all directions throughout the city.

Philadelphia is one of the best lighted cities in this country. We have at this time in use 6,361 electric lights, of which number the city pays for 6,228. These lights are a great protection to life and property, and it is in no sense false economy to increase the number of lights in every section of the city. This matter involves not only the question of illumination but of protection.

The matter of the establishment of an electric light plant to be owned by the city has not made much progress. An ordinance was passed by Councils providing for the selection of an expert by the mayor, one by Councils and another by the two experts so named. Pursuant to that ordinance I appointed an expert; Councils did the same, but the expert named by Councils declined to serve, and subsequently your honorable bodies appointed another. The matter is now in the hands of these two experts, to decide upon a third and make report.

Mr. Walker's report is long and interesting. Referring to the price of street lighting by arc lamps, he says: "The average price per lamp per night for 1895 was 41 15 cents; for 1896, 35.05 cents, and the proposals for 1897 show 33 3 cents, a reduction of $42,862.25—a sum sufficient to supply a large number of lights during 1897, without the necessity of an additional appropriation over the amount allowed for 1896."

Tables are given showing that there is a total of 27,431.8 miles of electrical wires in Philadelphia. Of this amount 21,295.68 miles are underground wires, principally belonging to the Bell Telephone company. Taking both overhead and underground conductors, this company has 17,377.41 miles of wires in Philadelphia; the Long-distance company has 1,069.42; Philadelphia Traction company, 880.19; Western Union Telegraph company, 842.71; Postal Telegraph-cable company, 693.16; Electric Traction company, 346 63; Brush Electric Light company, 298.70; People's Traction company, 237.44; Edison Electric Light company, 137.37.

Independent Telephone Men of Illinois.

The Independent Telephone Companies' Association of Illinois was organized at Springfield on June 17th, at a meeting held by representatives of about 25 companies. The following-named officers were elected;

President—I. A. Simpkin, Mattoon.
Vice-president—Frank Brooks, Charleston.
Secretary—A. M. Howell, Hillsboro.
Treasurer—M. Weinberg, Augusta.

I. A. Simpkin of Mattoon and Thomas Marshall of Keithsburg were elected delegates to the national association meeting at Detroit.

The differences between the city of Jefferson, Iowa, and the electric lighting company have been settled.

Electrical Production of Sodium.

By Orrin E. Dunlap.

Very recently the Niagara Electro-chemical company of Niagara Falls completed its electrical equipment by the addition of a new rotary of the induction type. This makes the electrical outfit of the plant consist of three rotary transformers, each of 175 kilowatts capacity, running at 500 revolutions per minute, and six static converters by which the multiphase current furnished by the Niagara Falls Power company at 2,200 volts is reduced to 118 volts, and arranged with Stillwell regulators by which the voltage is still further reduced to 90 volts, as may be desired. In Fig. 1 the first two rotaries installed in this plant are shown, while in Fig. 2 the new rotary of the induction type is to be seen. The field poles of this machine derive their magnetism from the armature, and there is no copper of any description about them. The switchboard in the Niagara Electro-chemical works is shown by Fig. 3. The electrical outfit of these works was supplied by the Westinghouse Electric & Manufacturing company, and installed by W. K. Dunlap, the Niagara representative of this company.

The Niagara Electro-chemical works form one of the imposing plants brought to Niagara Falls by the power development of the Niagara Falls Power company. The buildings are eight in number, of brick, and cover about an acre of ground. G. F. Brindley is the manager of the plant. The company was formed in 1895 with a capital of $100,000 to manufacture sodium from caustic soda and sodium peroxide from sodium, under the Castner electrolytic patents. Copper leads run from the switchboard to the pot room, and current passes in series through the pots, which are filled with molten caustic soda. The sodium is bailed out of the pots regularly and cast into bricks. The works have a very conveniently arranged recovery plant for caustic soda, the pump for the liquors being driven by an induction motor. An interesting process serves to convert the metallic sodium into peroxide of sodium. The sodium is first placed in regulated quantities into dishes, which travel through a long tube fixed in a furnace. Through this tube dry air in regulated quantities is passed, which is kept at a certain temperature, and the sodium is oxidized to peroxide. The peroxide comes out as a beautiful canary-colored substance, when it is at once sent to the grinding room, ground and packed.

In all about 50 men are employed in the Niagara Electro-chemical works, and they are divided into two shifts, as the process is continuous. A well appointed laboratory has been established in connection with the plant.

The principal stockholders of the company are the Aluminum company, limited, of Oldbury, England; the Deutsch Gold und Silber Scheidanstalt vorm. Roessler, Frankfort-on-the-Main, Germany, and the Roessler & Hasslacher Chemical company of New York.

The village of Bedford, Iowa, has voted to put in electric lights.

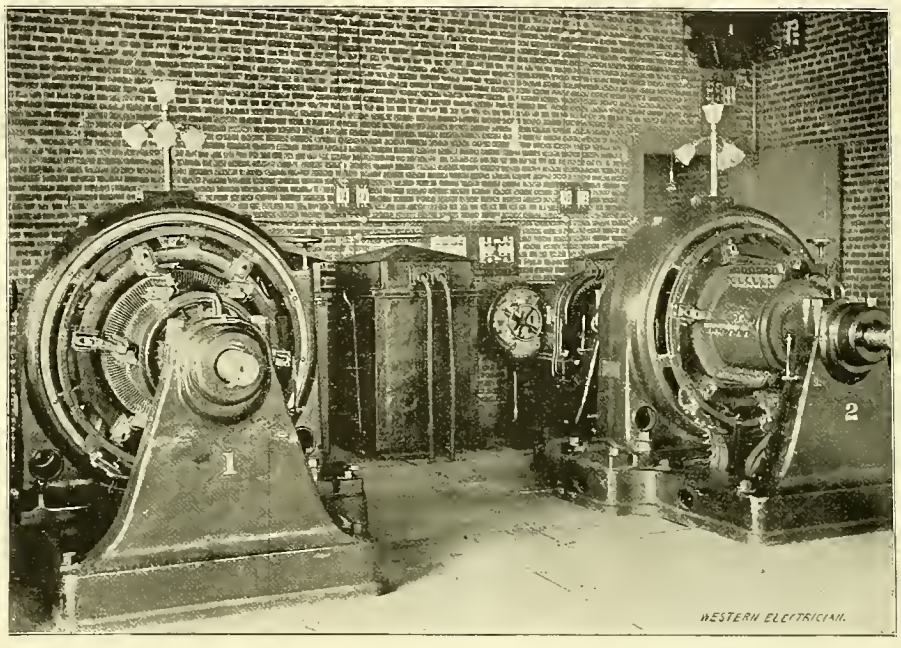


FIG. 1. ELECTRICAL PRODUCTION OF SODIUM.—ROTARY TRANSFORMERS OF THE NIAGARA ELECTRO-CHEMICAL COMPANY.

Recent Progress in Arc Lighting.[1]

By Elihu Thomson.

Part I.

It is now six years since I read a paper on "The Electric Arc and Its Use in Lighting" before this association. In that paper a general outline of the history and nature of the electric arc was given, together with a number of considerations relating to the arc as a source of illumination. The means for supplying current to the lamps and controlling the feed of the carbons were also touched upon.

Since that time considerable technical advances have taken place in this important field, and a continuous commercial expansion of arc lighting as an industry has resulted.

The purpose of the present paper is not, however, to deal with the commercial aspect of the case, except in so far as it is evidently the result of the improved devices which have been brought out in the last few years. In looking over the ground we find, also, that it is certainly not possible to deal very comprehensively with the several divisions of the subject within the limits natural to a paper such as the present one is intended to be. Should it serve as a foundation on which a general practical discussion of the various topics can be based, the writer's purpose will have been fulfilled.

We have, to-day, in actual commercial use arc lamps running under quite a variety of conditions as to nature of current, regulation of the current, and conditions concerning the arc itself as a source of light.

According to the manner in which the arc lights are worked on an electric circuit, we are enabled to make several general divisions, about as follows:

Series arcs on	Constant, continuous current circuits.
	Constant, pulsating current circuits.
	Constant potential, continuous current circuits.
	Constant, alternating current circuits.
Single arcs on	Branch of constant potential, continuous current circuit.
	Branch of constant potential, alternating current circuit.
	Compensators with alternating current.
	Constant current transformers.

The above schedule will cover most of the practical cases that have hitherto arisen, and each case can be considered both in its relation to the use of an open arc, an inclosed arc or a partially inclosed arc.

It will, at this time, be scarcely necessary to dwell upon the main features of several of the cases above enumerated, as they are too well known to call for comment here. Thus, the case of arcs in series upon a continuous, constant current circuit is the oldest and best known. It has the peculiar merit of permitting economical transmission by currents of potentials of several thousand volts; gives ease of regulation and great simplicity of circuits and connections, and does not demand the highest grades of carbons for the open arcs. On account of the relatively higher potential demanded by an inclosed arc, or a partially inclosed arc, and the consequent restriction of the number of lights in a series with a given permissible voltage, there has naturally resulted thus far very little real commercial use of series inclosed arcs, and where they have been on trial use they have, in most cases, so far as the writer is aware, been discontinued.

The dynamos for constant current arc lighting are not, of course, so efficient as high-class, constant potential machines, but as the running of arcs with constant potential, continuous currents demands that for steadiness or stability dead resistance or other additional apparatus, more or less wasteful of energy, be used in the lamp branches, what may be gained in one way is likely to be lost in another. And this remark, it will be found, is applicable still more generally in the comparison of methods of working arc lights.

In recent years the tendency in series arc lighting with constant current has been to increase of voltage of the

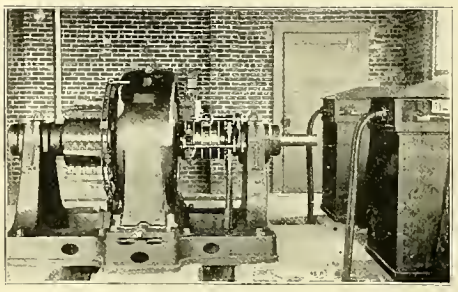


FIG. 2. ELECTRICAL PRODUCTION OF SODIUM.—ROTARY OF INDUCTION TYPE.

dynamo, and machines capable of working 125 to 150 arc lights in a series have been developed successfully. But the potential between terminals in such a case may be 7,000 volts—often too high for security, and in some places forbidden by special legislation. An ingenious method of employing such machines when, as is the case with the Brush machine, several commutators are present in series relation, has been devised by Mr. Green of the Brush company. This plan demands that separate pairs of wires be run from the machine to the switchboard for each circuit, but the unquestionable effect of the new connection is to limit the difference of potential which is possible to be manifested between any two parts of the circuit through the machine and lamps. A simple diagram like Fig. 1 will make the connection and its general effect on the distribution of potentials clear to those who may not have given attention to the subject. Let F be the field circuit of the dynamo; we may for simplicity neglect its resistance and that of the wire of the circuit. If C^1, C^2 and C^3 represent the sections of armature conductor, and L^1, L^2, L^3, the series of lights connected between the commutators of the machine, it will be seen that each armature section, C^1, C^2, C^3, with its appropriate commutator, acts to produce a difference of potential, which may be represented by the vertical a^1, $b^1 = a^2$, b^2, and a^3, b^3, while the fall of potential through each series of lights, L^1, L^2, L^3, results in bringing the line potential down, as it were, for another raising. In such a system, evenly loaded, the highest difference of potential anywhere to be found will evidently be that required to run a series of lights looped between two successive commutators. If lights are cut off from any set or loop, the potential difference between the terminals of that loop falls accordingly without any corresponding or proportional rise between any other parts of the circuit. If, however, lights are cut off one set and added to another, so as to keep the machine in full work with unbalanced loads, then the potential distribution is, of course, disturbed, and the system approaches the condition of all commutators connected directly in series, and the lights all in one series—the old plan. Where the conditions of the circuits leaving the station are such as to permit inductional effects on parallel wires—such as those of a telephone system—the new plan of circuit connections may give, as appears to have been already noticed, a greater inductive disturbance. This must be owing to the relatively simpler commutation per loop of lamps. In the old series connection all the commutators in series acted virtually as one of many segments, which tended to give a smoother potential, or prevent waves in the potential of the line. In the new plan each commutator of few parts acts, in a measure, independently of the others, and impresses its own variations of potential more directly on the lamp lines, giving rise to electrostatic inductional effects.

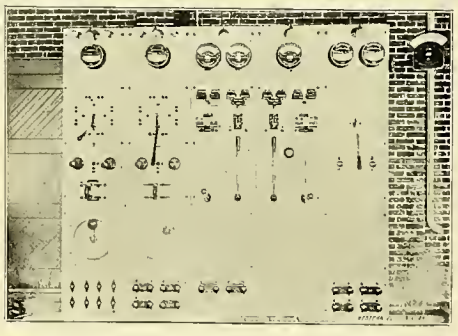


FIG. 3. ELECTRICAL PRODUCTION OF SODIUM.—SWITCHBOARD.

The immediate future of the series arc lighting system appears to be in the development of large dynamos, up to, say, 300 arc lights each, running at such speeds that one or a pair may be easily coupled directly to the shaft

1. Read before the National Electric Light association at Niagara Falls, N. Y., June 9, 1897.

of a moderately high speed engine. The use of a regulated constant current in the series system, besides giving a simple system as to wiring, etc., is seemingly best adapted to the use of the cheaper carbons. For extended districts the series arc lighting system is still likely to hold its own, but displacement by constant potential arcs and inclosed arcs on constant potential circuits will doubtless continue in cities supplied by underground low-pressure systems with continuous currents.

While it is true that in the open coil types of dynamos —such as the Brush and Thomson-Houston—the current, as set up by the armature, must necessarily be wavy, still it must be borne in mind that the field magnet coils, the line and the series lamp magnets have, together, a considerable inductance, the effect of which is to smooth out the minor fluctuations, so that the current becomes fairly uniform. A slight tremor in the current, with differential magnet lamps, is an assistance in preventing tardy feeling. In the pure shunt type of lamp, this is of less effect on the feed.

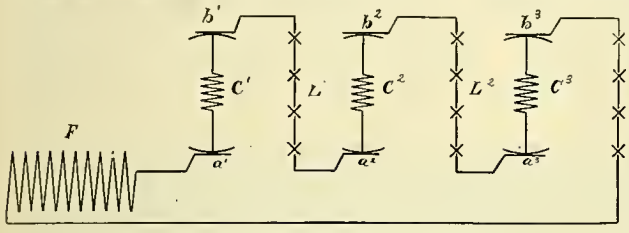


FIG. 1. RECENT PROGRESS IN ARC LIGHTING.

It has been thought by many that arc lamps are interchangeable (if made or adjusted for the same current) from the circuit of one type of series arc dynamo to that of another, without difficulty. In a general way this is true, but not by any means necessarily true. Thus, an arc machine may easily have that proportioning which enables it to run a circuit of differential lamps at a certain current strength and be wrong in proportioning for pure shunt feeding lamps, such as the Thomson-Rice M. & K. The latter require a more rapid droop in the curve called the "characteristic" of the dynamo, than the differentials. Also, it may happen that a dynamo which will take a certain load of differential lamps at a certain strength of line current, can only work with satisfaction on pure shunt lamps with a 10 per cent. to 20 per cent. increase of line current, and fewer lamps in series. In this case the differentials secure a stable current when working on a part of the characteristic curve back of that where the heavy droop occurs, *D* Fig. 2, while the shunt lamps are only given stable current at *S*. Instability or quick rise and fall with flashing and possible intermittent extinguishment otherwise result.

On the other hand, any circuit of pure shunt-feed lamps will take differentials adjusted for the same current without difficulty. But in such case, if the current fluctuates in value and there be but few differential lamps on the circuit, with a large proportion of the shunt-feeding type, the differentials are the ones to suffer and not the others. The former are sensitive to current variations, the latter indifferent thereto.

There is neither time nor space to devote to the details of arc-lamp mechanism for constant-current circuits, though much might be said in regard to the proportions that should be given to the parts, the character

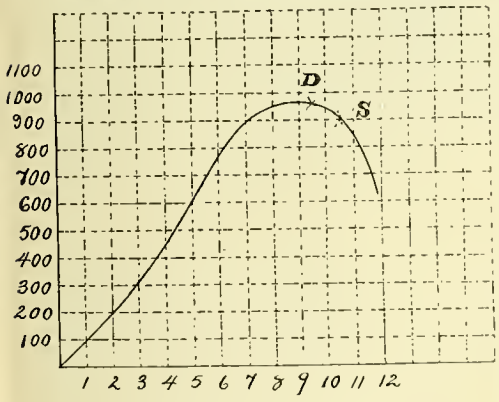


FIG. 2. RECENT PROGRESS IN ARC LIGHTING.

of pull to be secured in the magnets controlling the lamp, the securing in clutch lamps of a slow or "sneak" feed (as it is sometimes expressively, if not elegantly, termed) for the carbons, the cut-out switch, etc., in both differential and shunt-magnet control mechanism. There are two points, however, which may be touched upon in this connection, as tending to secure the best results. First, the variation of pull for a given variation of current in the magnets controlling the lamp should be as great as possible. Second, there should be as little as possible variation in the force required to feed or recover from feeding. The force required to be imparted to the mechanism to release the clutch, detent or escapement should be as little as possible, and but a very small fraction of the total magnetic force in a differential or shunt-feeding system. Otherwise, the lamp will not be a sensitive feeder. Lamps are frequently found which form their arcs well enough, but hang up or delay at the feeding point, the action of feeding being preceded by quite a rise of potential between the carbons at the arc. This is owing to too much force being required to unclutch or release the mechanism. A good lamp should feed on a variation of three to five volts, and, with certain constructions, a feeding action within one-half to three-quarters of a volt variation for a 45 volt arc can be readily attained.

Passing now to the consideration of the use of pulsating currents in arc lighting, it may be said that at present little or nothing has been done commercially in the United States in the use of such currents. The subject becomes one of importance in connection with what are known as rectifiers. These are machines that take an alternating current and commute the waves, or rectify them, so that the flow of current is in the same direction always, though rising from zero to a maximum for every alternation in an alternating current. The more or less near approach to continuity of current will depend upon the shape of the wave rectified. A rectangular wave, properly rectified, would, as in Fig. 3, give a true continuous current. Other forms of wave give less continuity, depending on the sharpness of the individual wave peaks, *c*, *d*, Fig. 4. The character of arc produced by the rectified current resembles closely that of the continuous-current arc, in that the crater in the positive carbon is present, and the negative tends to point itself. There is, however, a strong note or sound evolved from the arc, depending for its pitch upon the periodicity or frequency of the alternating current. The inductional effects of the pulsating currents in lines upon neighboring lines will, of course, resemble those of alternating currents, though less musical than the latter when a sound results, as in a telephone. In order to make it easy to commute or rectify such a high potential of alternating current as would be needed to feed, say, a series of 40 to 50 arc lamps with pulsating current, certain conditions are very desirable. One of these is that the current to be rectified should be of constant value, though alternating. The writer showed, nearly 10 years ago, how a constant current transformer could be made, using primary current at constant potential to obtain secondary constant current. One of the ways was to so mount a secondary coil, with relation to its primary, that repulsion might be exerted between them and so move one away from the other when a tendency to increase of current in the secondary took place. This method was found to be highly efficient, and was embodied in a number of forms of apparatus, some of which were employed to feed constant current to arc lamps in series. In this case lamps may be cut out and the secondary coil even short-circuited, while the current in it remains practically constant.

When such a current is rectified the same characters are preserved, and the regulation is all that could be desired for all loads within the capacity of the apparatus. The efficiency of transformation is also quite high, and the apparatus is not of excessive size for a given output. A simple commutator revolved by a properly constructed synchronous motor, with its arc-machine brushes and air-blast, complete the machine. By the use of the air-blast a single commutator, as in the Thomson-Houston arc machines, serves to rectify a single alternating current wave of sufficient potential for up to 50 or more lights in a series. Without the air-blast flashing would be likely to be serious at 15 to 20 lamps in a series.

The above relates to the rectification of a single-phase current. When, however, two-phase or three-phase currents are to be rectified, there will be at least two or three constant-current transformers, one for each phase, and the secondary current may be combined through commutators resembling those of the Brush arc dynamo for the two-phase, and the Thomson-Houston for the three-phase. In such cases the resulting rectified current is much more nearly a steady or smooth current, and not so much of a pulsating character. This is, of course, owing to the relation of the phases being such as to cover each other's zeros or to overlap. Under proper working conditions there should be a certain field for the use of rectifiers in the United States, as well as in England, where Ferranti has for some time past had some of them in use. It is difficult to adapt a rectifier to periodicities of as high as 125 per second, but with 60 periods the problem is comparatively easy. The use of rectifiers has the one great advantage of permitting the generation of current in a station to be by means of large direct-connected dynamos, a portion of the output of which is used in the ordinary way to feed lights, etc., through the usual constant potential transformers, while another portion, feeding rectifiers, supplies the arc lamps of the system instead of special arc dynamos; while, if needed, the whole capacity of the generator may be utilized for one or other kind of load, as desired.

The arc lamps worked by rectifiers are like continuous current arcs in giving the downward distribution of light from the positive crater, a feature of great value in street lighting. There if also complete regulation—such that lights may be cut out *ad libitum* by shunting, while the other lights remain unaffected. Furthermore, the efficiency of the rectifier is high, and may easily be made over 90 per cent.

Two or more arc lamps are now often connected in a branch across constant-potential mains or supply lines. Thus, on 110 volt circuits, two lamps using about 43 to 45 volts each, and with a proper choking resistance, may be found in the branch. On 220 volts there may be four lamps in a series, and on railway circuits of between 500 and 600 volts nine to eleven lamps may be found connected, with, in each case, a proper resistance. The inevitable use of a choking resistance in series, with arc lamps run from constant potential lines, is now pretty generally understood. Without it the current in the lamp branch is unstable, owing to the fact that the resistance of an arc is not a definite quaotity, but varies for a definite length of arc in inverse ratio to the current flowing, or even falls more rapidly than the current increases, or *vice versa*.

Therefore, the current strength of the arc lamps in this case is not to be regulated or controlled by adjustments of the lamps alone, but by means of the variation of the choking resistance in addition. The object in each case is to set the value of the resistance at such an amount as will, when the arc lamps are adjusted to feed at, say, 44 volts, with good cored carbons, give the desired value of current and stability of current. The quality and character of the carboos used has a decided effect on the results as to steadiness and uniformity in constant-potential arc work. Hence, a good cored positive and solid negative are desirable. The writer has seen no more perfect result in arc lighting than can be obtained on constant potentials, with good lamps and carbons burning open arcs. Much was said, and some considerable amount written, a few years ago about lamps in series on constant potential robbing each other, so that when one was bright the other was dim, and the reverse. This phenomenon does not occur with properly constructed lamps, which are sufficiently sensitive feeders. Lamps for this service, capable of feeding within one volt variation at the arc, are in use, and the steadiness and reliability obtainable is all that can be desired.

In regard to "inclosed arc lamps," it may be said that they are beginning to be applied in a series of five upon circuits of 500 volts potential, but the consideration of

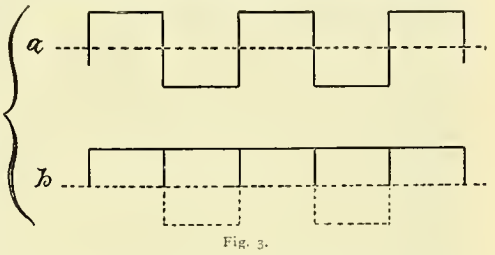


Fig. 3.

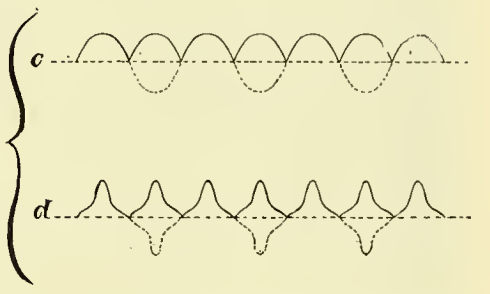


Fig. 4.

RECENT PROGRESS IN ARC LIGHTING.

this type of arc will be deferred till later, when the subject of single lamps on constant potentials is discussed.

The distribution of current for arc lighting at constant potentials has undoubted advantages, one of which is the relatively low tension and absence of danger. Another is the facility of installation along with incandescent lights, and ease in metering the supply. The loss of energy in the distribution may, at full load of lines and moderate distances from the supply station, be, say, 10 per cent. or more, chargeable chiefly to feeder drop, and about 15 or 20 per cent. in dead resistance in the lamp branch. We may take, then, 25 per cent. as an average loss in reaching the lamps. This loss, which is much greater than the percentage of loss on the series system, is yet largely, if not wholly, made up by the superior efficiency of the constant potential, low-pressure generators of large capacity over that of arc machines of relatively smaller output, and by the higher engine efficiency which may readily be attained in driving large generators, especially when working with economical loads. It must not be forgotten, however, that for equally good results a better and more expensive carbon will be required for constant potential work than for plain series arc lighting. These observations relate, of course, to ordinary arcs with full supply of air reaching the hot ends of the carbons. The conditions existing with long-burning lamps or inclosed arcs will be alluded to later.

One serious objection to the arrangement of lamps in series between constant potential mains, especially those of 220 to 500 volts, is the inflexibility, or inability, to cut off some lamps in a branch without substitution of equivalent resistance, which substitution, of course, means that the same watts are consumed, whether the lights burn or not. We lose the advantage of the constant current system, which enables us to shunt lamps and save power, and also that of the simple multiple arc or parallel system at constant potentials, in which each lamp is in its individual branch circuit. Open-circuiting the branch extinguishes the light and saves power. With alternating current at constant potential there is greater flexibility, but, unfortunately, no alternating-current arc lamp is likely to equal in its effects lamps making use of continuous currents or undirectional currents.

There are two ways in which alternating currents

may be used to work arc lights in series. We may either take a constant potential system, such as one with main lines at 1,000 volts, and connect between them a series of arc lamps at about 30 volts each and about 35 lamps, or we may transform so as to feed the lamps in series with a current of constant value, or with a current which does not vary more than a given per cent., from light to full load—15 per cent., for example. In the former arrangement some provision must be made to allow lamps to be extinguished without breaking the circuit, and this cannot be done by shunting, unless equivalent resistances be substituted, for the shunting of a lamp or lamps in a series would result at once in a great increase of current in the others and a serious departure from normal working.

By shunting each lamp in the series by a specially constructed and carefully proportioned reactive coil, wound upon a laminated core, the difficulty just pointed out is obviated with but small sacrifice. The reactance of the shunting coil is adjusted to give, when two to three amperes of current traverse it, a potential between its terminals just sufficient to work the arc lamp which it shunts, and the gauge of wire of the coil must be ample to carry the full current of the line, for, in this case, the arc lamp is extinguished by simply open-circuiting it, while leaving the reactance in circuit. It is also necessary that the iron core of the coil shall be at, or near, magnetic saturation when the arc lamp is burning, so that its reactance shall not greatly increase when, by accident, the lamp fails to feed or it is purposely open-circuited and the coil has to carry the full line current. In such a series, provided with shunting reactances, the ordinary series magnet in the lamp, for separating the carbons to form the arc and regulating the same, is all that is needed, since the variations of current alone are sufficient to serve the purpose, no shunt or differential magnets in the lamp being called for. It will be understood that the apparent energy consumed in the reactances is not, in fact, wasted, for the phase relation of the current is such as to make the current in the coils approach a wattless current or one with a low power factor. For example, a coil which shows 2½ amperes of current and 30 volts, or approximately 75 watts, may, in reality not consume more than 10 to 20 watts. Another way of accomplishing even a better result, but one which requires that shunt or differential magnets be used in regulating the feeding of the carbons, is to substitute by a special switch a proper reactance in place of the lamp when it is to be cut out, and also to cause the lamp, on a failure to feed, to cut in as a substitute for itself this reactance. In such a case the construction of the reactance may be such as to waste very little energy, but the existence on a system of a considerable number of arc lamps and many reactances, which would be the case when a large proportion of lamps were cut off, would have the effect of loading the system with inductance to an extent which might interfere with the proper regulation of potential at the generator. In any case these systems of working may be set aside as not having reached any decided commercial importance. They are mentioned here by way of comparison, as they present instructive features.

When a transformer is so constructed that there may be a considerable magnetic leakage, as it is termed, between the primary and secondary coils, it approximates what is called a constant current transformer. It will, if connected by its primary terminals across mains at constant potentials, give a secondary current which, even at short circuit, is only a moderate percentage in excess of that given when the secondary is carrying a considerable load.

In fact, such a transformer has an analogy, which is unmistakable, to a direct-current arc machine with a drooping characteristic, before alluded to. When, however, the amount of magnetic leakage in the transformer is carefully proportioned, or when, as in the rectifier transformer with repelled movable coils, the leakage is allowed to adjust itself, a substantially unvarying value of alternating current is delivered at all loads from short-circuit up to the full load, or highest available working potential. The transformer then resembles an arc machine with an instantaneously acting and perfect regulator, or such a machine with a characteristic curve which droops vertically. This would mean the preservation of the same current at all potentials. By properly proportioning an alternating-current dynamo, the same property of constant current has been given to the machine.

For arc lamps in series on alternating current, this constant-current property is perfectly adapted. But in this case the regulation of the lamp must be by a shunt magnet responding to the potential across the arc, and not to the current passing through it, which is constant. Of course, the shunting reactances before mentioned might be used, but these would have no particular function in this case, since the system of supply permits free shunting of the lamps, and the current is the same even down to short circuit. Numbers of lamps were installed several years ago by the Thomson-Houston company, and worked in the way indicated, the transformers being of approximate constant potential property, but the writer does not know to what extent they are still in use. That the system is not entirely dead was indicated by a recent demand for additional transformers of the same type, though for quite a period none were supplied or asked for. The system has its merits, like the series arc system with direct currents. It does not demand the highest grade of carbons, and the lamps are not liable to chatter at starting.

Futher consideration of the nature of an alternating arc in relation to the light-giving effect and to the mechanism which must be used to control the lamp, carbons, etc., will be given later.

We may now consider the use of single arc lamps on the various circuit arrangements adapted to their supply. With the ordinary constant potential, continuous current circuits of about 110 volts, it is manifestly not desirable to operate a single lamp, taking, say, from 40 to 50 volts, and waste the remainder in resistance; yet, oftentimes, it is quite undesirable that two lamps in series be connected to the mains, on account of the inability to use one or both, and one may be quite enough. The gap is filled by the "inclosed arc," and, at the same time, the necessity of frequent trimming, a disadvantage with the open arc, is obviated. The inclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons, or carbons containing little or no ash and particularly free from such metals as iron, the oxides of which are deep black or brown, which would soon obscure the small globe around the arc.

The inclosed arc of to-day merits more than a passing consideration, on account of the general interest which has arisen in regard to it among electric light engineers. The idea of burning an arc in a practically closed and relatively small glass chamber is quite old. It was known also that the carbons would burn blunt or nearly square on the ends, and would require a relatively wider separation to let the light out; that they could be made to burn relatively more or less pointed by letting in more or less air. Early experimenters in this field were met at the outset by the serious difficulty of obscurations of the inclosing vessel by deposits generally brownish, and probably due to oxide of iron, the iron being present in the graphitic carbon used in forming the carbon sticks. The writer met this difficulty in 1879, and for many years after that date there was not to be found such pure carbons as would give so little deposition as is required to work an inclosed arc practically.

Curiously enough, as late as about 1890 there was a revival of the inclosed arc as applied to arc light circuits in place of the ordinary series arc lamp. The sealing of the arc, so to speak, was such that about 65 volts were required to work it. A saving of carbons was effected, but the number of lights obtainable from an arc dynamo of any given capacity was seriously reduced, as was also the commercial value of any arc light line whose potential was limited either by law or circumstance. Contrary to the original expectation of its promoters, the use of inclosed arcs on series circuits did not progress rapidly and soon retrograded. Many causes, besides the one of

THE FIRST CLASS GRADUATED FROM THE ARMOUR INSTITUTE OF TECHNOLOGY.

reduced capacity of lines, had undoubtedly an effect. Cheap carbons for open arcs, impure carbons for inclosed arcs, breakage of inner globes—resulting in rapid consumption of carbon—obscuration of light, etc., must have contributed largely to the result.

When it is remembered that, to get the best results with arc lamps on constant-potential circuits, the use of rather expensive cored carbons is necessary, the saving of carbon and frequent trimming becomes a very important item and permits the employment of more expensive carbons, provided they last long enough. The high voltage demanded by the inclosed arc was soon seen to be not a disadvantage, but a positive advantage for constant-potential circuits, inasmuch as it permitted the use in one lamp of a larger fraction of the total—generally 110 volts. Hence, instead of keeping down the potential, it could even be raised from 65 to 75 or to 80 volts with advantage. In fact, it may be that the exclusion of oxygen has the effect of enriching the arc flame itself, in much the same way that a slightly luminous blue flame of a Bunsen burner becomes far more luminous by cutting off the air. There may, in fact, be free condensed carbon particles in the outer layers of the arc stream highly heated and, therefore, strongly luminous. The flat ends of the carbons tend, also, to cause the hot gases to be retained under the positive end, thus extending the heat of the crater and increasing the luminosity. The result of the almost complete exclusion of oxygen is that very little combustion takes place and the life of the carbon is therefore much extended. The function of the small glass vessel around the arc is not only to keep out the air, but, in addition, to act as a diffuser of the light evolved, and in this sense replace, to a considerable extent, an opal outer globe of large dimensions, necessarily thick and highly absorptive. The inner globe around the arc is made thin, to withstand heat without cracking from sudden changes of temperature, and is generally of clear glass with a thin coating, either internal or external, of an opal or alabaster-like glass, which, by the materials employed in its composition, gives a large diffusive effect without undue absorption. The inner globe is often also given a yellowish color or absorptive effect for the disagreeable violet rays, of which the long arc flame is so strong a source.

Owing to the traverse from side to side of the arc between the square ended carbons, the direction in which light is emitted from the arc most effectively is undergoing continual and very great changes, so that the intensity of light in any given direction may, in a few seconds, vary several hundred per cent., and with a perfectly clear glass inclosing globe this variation would not only be quite noticeable, but in many cases intolerable. The diffusive power of the glass, however, is such, in the case of the opal coating, that the traveling of the arc is, in large measure, compensated, and the general effect is that of a very steady, uniform light. Were it not for the diffusive power, the color of light, as well as the intensity, would change greatly; as when the arc happened to be on the side of the carbons away from the observer, the light would then be in greater proportion from the purple or violet arc flame, and less from the glowing ends of the carbons themselves.

The carbons to be used in an "inclosed arc" should be of the very highest grade as to purity, not too hard or dense, as straight as possible, uniform in diameter and circular in section, and should be obtained of as near a standard diameter as possible, so as to avoid the necessity for adjusting the caps of the inner globes to the size of the carbons. It is necessary that the caps should fit pretty closely around the carbons to avoid leak and consequent reduction of life. Leaks of air into the inner globe must be carefully avoided, if any reliance is to be placed upon a lamp for a given run without recarboning. During the run the upper part of the inner arc-inclosing globe is coated slowly with a deposit, nearly white in color when the carbons are free from iron, and consisting of what little mineral matter has been left in the carbons. Fortunately, the hot uprising currents from the arc deposit considerable of this on the cap above and return to the arc to be reheated and again circulated at a little above the level of the arc itself, and, as the lower carbon consumption gradually causes the arc to descend, the light of the arc continually reaches portions of the glass wall which have been but slightly obscured by the deposits from prior burning. In general, the deposit which forms on the inner globe can be wiped off or dusted off at the time of recarboning. Carelessness in this particular may easily result in a large proportion of the light of the arc being lost, and, what is perhaps worse, the radiant heat and light of the arc, being unable to escape, goes to overheat the glass of the inner globe, either melting or deforming it so as to produce leaks, cracking it directly or burning the deposits into its surface. After this they can only be removed by such agents as hydrofluoric acid applied to the surface.

The mechanism of an inclosed arc lamp to be run singly in branches from 110 volt circuits is naturally very simple. Since the lamp regulates entirely by variations of current on its circuit, a simple series magnet suffices. No cut-out other than a fuse in the lamp branch is needed.

The switch is a plain open-circuiting switch. A choking resistance is mounted on a lamp or elsewhere in the branch, the drop over which is about thirty volts. The upper carbon or its holding rod is acted on by a simple positive clutch. There is required, however, even in such a lamp, so apparently simple in itself, great care in proportioning the parts and their relative actions, to secure the best results. If the constructor fails in any detail, the behavior of the lamp soon tells the story—the current is interrupted frequently; the voltage around the arc varies greatly; the current, as well as the light of the lamp, varies.

The First Class Graduated from the Armour Institute of Technology.

The graduation of a class from an institution but recently founded, and of necessity bidding for estimation in the eyes of a critical public, is a matter of considerable moment. Institutions, not unlike individuals, must appear for judgment, and be assigned a verdict more or less just. However finely and thoroughly equipped an institution may be, it cannot secure general favor or approval on such basis alone; rather will its rank be determined by other factors, such as the value of the research and investigation accomplished, the character and influence of its faculty, and the character of the training it has given the men it sends out into active life.

The graduating exercises of the first class from Armour Institute of Technology were held in Plymouth Church, Chicago, Thursday evening, June 17th. The Armour Institute address was delivered by President Daniel C. Gilman of Johns Hopkins University. His subject was "The Remedy for Discontent," The address was a masterly one, and an elaboration of an educational article which President Gilman recently contributed to the *Cosmopolitan Magazine*.

The degree of bachelor of science in engineering was conferred on 22 graduates. Five of the number graduated from the mechanical engineering course, as follows:

Thesis, Efficiency Test of a Cross Compound Engine: F. B. Hall and F. C. Johnson, Chicago; R. V. Perry, Denver, Col.

Thesis, Test of an Otto Gas Engine: N. M. Loney, Fort Wayne, Ind.; J. J. Wheeler, Chicago.

The 17 who graduated from the course in electrical engineering presented the following theses:

Thesis, Characteristics of a 100 Kilowatt Western Electric Continuous Current Multipolar Dynamo: P. R. Chapman, W. F. Sims, B. H. Glover and J. R. Sloan, Chicago.

Thesis, Characteristics of a 50 Kilowatt C. & C. Bipolar Dynamo: R. H. Rice and M. Salamson, Chicago; F. D. Sheibley, Streator, Ill.

Thesis, Characteristics of a 25 Kilowatt Fort Wayne Alternating Current Dynamo: E. S. Church and G. Mahony, Chicago; B. R. Jamison, Newport, R. I.; I. S. Prenner, Kovno, Russia.

Thesis, The Design and Installation of a D'Arsonval Galvanometer: C. E. Freeman, Topeka, Kan.

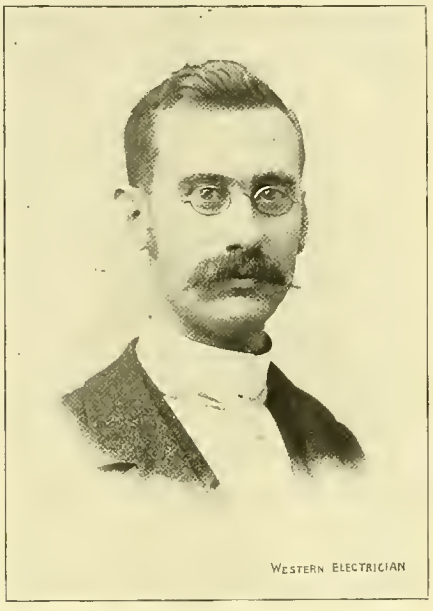
Thesis, The Carrying Capacity of Wires in Conduits: E. D. O'Brien and E. Richardson, Chicago.

Thesis, The Investigation of a 1,500 Watt Transformer: C. T. Macolmson, Chicago; G. L. Matt, Lancaster, O.

Technical education being still in the formative state, there reasonably exists wide divergence of opinion as to what should constitute the subject matter of an engineering course of instruction, and its presentation and correlation as well. By many the merely descriptive investigation is considered all important, but careful thought must show that all engineering practice is ultimately an extension of mathematics, physics and chemistry. Especially is this the case in electrical engineering, whose leading characteristic is undoubtedly mathematical physics. It has been such consideration which has developed the course from which the present class graduated. It was this same consideration which guided the selection of the large equipment in the electrical department of the Institute, which contains much usually found only in the set physical departments of older institutions.

Logically, then, the work in electrical engineering extended over the entire four years of the course. During the first two years the technical and physical aspects of electricity and magnetism were intimately associated and carefully co-ordinated. The favorable results obtained are the best justification for such a radical departure from previous usage. The mathematical portion of the course has been strongly emphasized, and special stress has been laid upon the calculus and differential equations, the course being guided by the applications, especially in the departments of physics and electricity.

This class has prosecuted probably more laboratory practice in electrical measurements in quantity and variety than has yet been given elsewhere. The leading features of this work have been the attention devoted to the investigation and calibration of instruments used for measuring potential current and power, and the characteristics of both alternating and direct current machinery. Insulation testing, the determination of the magnetic properties of iron and steel, photometry, alternating current measurements and allied subjects have also received due attention.



PROF. WILBUR M. STINE, DIRECTOR ELECTRICAL ENGINEERING DEPARTMENT, ARMOUR INSTITUTE OF TECHNOLOGY.

PROF. TRUMAN P. GAYLORD, ELECTRICAL ENGINEERING DEPARTMENT, ARMOUR INSTITUTE OF TECHNOLOGY.

The first commencement of a school devoted to the interests of higher technical education is an event of moment in the history of Chicago. If the school is true to the high trust which it has assumed, and wise in its organization and administration, the generosity of Philip D. Armour will have much to do towards shaping the industrial position of the city. A group picture of the first graduating class is herewith reproduced, together with portraits of Professors Stine and Gaylord and a representation of the class pin.

The instructors in the department of electrical engineering are the director, Wilbur M. Stine; Truman P. Gaylord, associate professor; John E. Snow, in charge of dynamo laboratory; Herbert Gaytes, associate in the laboratory; Clarence E. Freeman, and William H. Derby, instructors.

At a special meeting of the City Council of Farmington, Mo., on June 17th, a franchise was granted to W. E. Bailey and his associates and assigns, to be incorporated as the De Lassus and Farmington Railway & Power company, to build a road from the railway station De Lassus to Farmington, a distance of three miles, also a contract to light the city for a term of 10 years with six arc lights and 40 incandescents of 32 candle power, at an annual rental of $1,400 per year. The company has purchased the present electric plant, and proposes to consolidate the two under the above title. Surveyors will go on the ground at once, and it is proposed to have the road and lights in operation by November. Farmington is a town of 3,000 people.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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WITH the Niagara Falls convention number of the WESTERN ELECTRICIAN, dated June 12, 1897, this journal made a new record for itself both in circulation and advertising. Of this 100-page number 20,000 copies were printed and circulated and the amount of full paid advertising matter carried was 8,643 square inches.

The remarkable success of this journal, especially in view of the hard times that have prevailed throughout the country, is all the more striking because of the fact that it is only 10 years since the first number was issued. Its advancement has been rapid and in keeping with the progress of the great industry it represents and the splendid field which it occupies. It is a noteworthy fact, especially in view of existing conditions, that during the period of depression this journal has made steady gains in advertising. Beginning with the convention number of March 3, 1894, the record shows constant gains each year until in the present case the number of square inches of full paid advertising matter is more than double that of the 1894 number. The figures showing this unprecedented gain are given in the accompanying table:

Issue.	Number of Advertising Pages.	Whole Number of Pages.	Square Inches of Paid Advertising Matter.
March 3, 1894....	40	56	4,145
February 23, 1895.	52	68	5,593
May 9, 1896.....	72	88	7,576
June 12, 1897.....	80	100	8,643

This constantly increasing patronage speaks eloquently of the influence and merit of this journal and of the confidence and respect which it commands throughout the country. It is pleasing recognition of the efforts that have been made in the interest of the entire fraternity.

THE annexation of Hawaii by the United States will solve the question of the establishment of a Pacific cable, as it is admitted by friends and opponents alike that favorable action by the United States Senate upon the proposed treaty will be followed immediately by a bill providing for the establishment of telegraphic communication between Honolulu and Washington. A cable would under the circumstances be a political and military necessity, and it is quite probable that this government would build it at once. Extensions to the coast of Asia could be made later on, either by the United States government or by a private company representing American and Asiatic interests. At any rate it would seem as if annexation would dispose of the Canadian-Australian project so far at least as the landing of the cable at Hawaii is concerned.

TWO months ago, throwing such influence as it had with many other expressions of public and private opinion, the WESTERN ELECTRICIAN appealed to Mayor Harrison to rid the city of Chicago of John P. Barrett, who, as city electrician, had a bad record and a demoralizing influence. The mayor recognized the justice of the case made against Barrett and secured the desired resignation. This action put a stop to Barrett's pernicious activity, and also, it is hoped and believed, gave an effective quietus to that course of conduct—or misconduct—in the city electrical department which has been verbally epitomized as Barrettism.

Now the mayor has supplemented his good work by appointing a new and clean man to take charge of the department. We congratulate him and we congratulate the new superintendent. In Mr. Ellicott we believe that the city has secured an honest and capable servant—an electrician in fact as well as in name, and a man with the stamina to uphold the convictions of integrity. Like the mayor himself, he is a young man, with his public career all before him. The mayor has made a good beginning—most auspicious indeed in this Barrett business—and we confidently expect that Mr. Ellicott will do likewise, and continue the good work.

CHICAGO has a technical college that reflects credit upon the city. It has not the advantage of long established reputation, which can only be acquired after years of successful work, but it is laying the foundation for a career of usefulness, and with the vigor and enthusiasm of youth it is already commanding recognition in the engineering world. Last week the Armour Institute of Technology conferred degrees for the first time, the class of '97 being the first to complete the course in engineering, and now the institution may be said to have taken its place with other schools of this class. But it must be admitted that while only beginning its work, this institution in the four years of its existence has made an excellent reputation and that it has gained a standing in the engineering world that many older schools have vainly sought. The work of the Institute, especially in the electrical department, has been directed by able minds, and the facilities at command have enabled the students to engage in much original work that could not otherwise be followed. In many respects, it is claimed, the equipment of the electrical engineering department is superior to that of any other institution in America. Cornell and McGill universities surpass in certain special departments, but in others equally important, it is contended, Armour Institute excels even these renowned educational centers. Much credit is due to the gentlemen who have organized and developed the course of study and laboratory work to be pursued and also to the founder and patron of the institution, to whose generosity the city of Chicago and the cause of technical education owes so much.

A PROJECT that may result in further power development at Niagara Falls is attracting the attention of Canadian officials at the present time. On suggestion of prominent citizens an engineer took levels of the lower Niagara River along the famous Whirlpool rapids from the cantilever bridge to the whirlpool, and found that there is a drop of 46 feet in the river's level between the two points mentioned. The commissioners of Queen Victoria Park had their attention called to the power possibilities presented at this point, and they have also taken levels which corroborate the original report, the commissioners' information being that the drop is from 45 to 50 feet. These results were presented to the Board of Trade of Niagara Falls, Ont., and that body passed a resolution pointing out the advisability of the town council making some arrangement with the park commissioners, the controlling body, whereby the town might be given a franchise for the purpose of developing the power. At its last session the Ontario Parliament granted towns in the province authority to engage in the development of power, and it is believed that under the privileges thus conferred the town of Niagara Falls, Ont., may obtain from the park commissioners some recognition of its claims. Despite the fact of the fall in the level of the water of the river between the two points mentioned, the cantilever bridge and the great whirlpool, it will require further evidence, based on more careful examination by engineers, to convince investors that the development of power at the point could be made profitable. The spot is at the side of the Whirlpool rapids, and the current and rapids are very fierce for the whole distance between the points. It is probable that any plan adopted would mar the beauty of the Canadian river bank, but certainly not more so than the construction of the Gorge road has the American bank.

RECOGNITION of telephonic communications is becoming quite common by the best legal authorities of the country, and, where certain conditions are complied with, any transaction made in this manner is held to be binding. Following comparatively recent decisions of the highest courts in several states, and on principle, the Court of Appeals of Kansas has just declared that it should not hesitate to hold that business communications or notices over the telephone are as binding as if the telegraph or mails were used. Ordinarily a *prima facie* case can be made out notwithstanding there is no proof that the person sending a notice, or relying upon it in the action, knew that the person receiving and answering the message was the identical person for whom it was intended, provided it be shown that both telephones were connected with the central telephone office, and that the proper number was called for, connection made, and response received upon its being called.

The cases in point clearly show that the use of this modern means of communication is to be recognized and welcomed by the courts, as well as by the business interests of the country, but the doctrine of these cases cannot be applied in any general way. The facts of each case must be considered. Thus, the court further holds in one of the decisions under consideration, that, while a witness may ordinarily testify to a conversation had by him through a telephone with a person, though he is not able to identify the voice of the person responding, yet, where it is sought to charge an indorser of a promissory note with liability by a notice of dishonor thus communicated, it must clearly appear that the person responding was the indorser himself; and where the only evidence of the giving of such notice was the testimony of a witness that he called up the office of the indorser, and did not know positively that it was the indorser or his bookkeeper, or either of them, who responded, it was not error to sustain a demurrer to this testimony, as furnishing no evidence that notice of dishonor was given. This is one of the cases that illustrate the special conditions that must be considered.

Railway Telegraph Superintendents.

The Association of Railway Telegraph Superintendents held its sixteenth annual convention at Niagara Falls on Wednesday and Thursday, June 16th and 17th. In the absence of President George M. Dugan of Chicago, Vice-president J. W. Lattig of the Lehigh Valley, of South Bethlehem, Pa , presided. The papers on the programme were: "Relays and Their Resistance," by Thomas D. Lockwood of the American Bell Telephone company of Boston, Mass.; "The Apprenticeship System," by George C. Kinsman of the Wabash system of Decatur, Ill.; "Railroad Telegrams," by C. Selden of the B. & O. of Baltimore, Md ; "The Telegraph," by A. R. Swift of C. R. I. & P. of Chicago; "The Delivery of Commercial Telegrams at Railroad Stations," by L. H. Korty of the Union Pacific of Omaha, Neb.

Mr. Korty was unable to be present, but his paper had been forwarded to the secretary, who read it. Much of what Mr. Korty wrote is of public interest, and especially the following pointed statement about the delivery of messages to passengers on trains:

Many telegrams are received at stations addressed to passengers on trains. These must necessarily be given to the train conductor to find the person. The conductor may be unable to give it personal attention, and he, therefore, turns it over to the brakeman to find the owner, but "Brakesy," in his anxiety to resume his seat with the woman passenger whom he is entertaining, does not make a thorough search through the train, puts the message in his pocket and the matter is forgotten until the usual claim for damages on account of non-delivery is received. Investigation proves but one thing, namely, that the message was received at the station, but nothing further is on record. The operator claims he turned it over to the conductor of the train, but has nothing to show for it, as he failed to take his receipt. The conductor disclaims all knowledge of it. Asked why he does not take receipts for commercial messages delivered, the agent in this case may reply that he does take receipts from everybody except conductors, who usually decline to receipt and be responsible for telegrams for parties on trains. Under these conditions there is no certainty that a message will ever reach the owner, or, in case of failure to find him, that the sending office will be notified of non-delivery.

Most of the irregularities in delivery service exist at the small offices where there is no messenger and not sufficient business to justify the employment of one, the agent performing all the duties of the station, including delivery of telegrams; and, as station employes too often look upon the commercial telegraph business as an outside matter, imposing upon them duties for which they receive no compensation, this branch of the service is most likely to suffer and be subject entirely to their personal convenience; yet the telegrams received at these thousands of small railroad offices constitute a considerable portion of the whole telegraph business of the country, and, therefore, justly demand our careful attention and individual efforts to improve.

Although a railroad company may not share directly in the telegraph earnings, it is compensated in one way or another through its arrangements with the telegraph company, and, aside from the contract obligations properly to handle the telegraph business at stations, there is a moral obligation on the part of the railroad company toward communities and patrons who are dependent upon its employes for this important service. An agent charged up with the tolls on a message delayed or lost through his negligence, generally profits by the experience and is thereafter usually more watchful of this business; but we should not wait for our employes to be educated in their duties by this means. The paltry amount of tolls refunded to the claimant does not entirely appease his feelings and he will always entertain a lack of confidence in our telegraph service as well as the service in general at railroad stations.

The new officers of the association are as follows: President, J. W. Lattig, of South Bethlehem, Pa.; vice-president, W. W. Ryder of Chicago, Ill.; secretary and treasurer, P. W. Drew of Milwaukee. Hot Springs, Ark., was selected as the next meeting place in order to satisfy members from the far West.

Baseball Pitching Gun.

In a recent baseball game at Princeton, N. J., the new "baseball pitching gun" was used, the machine pitching for both clubs. The gun is discharged by the batsman, who when ready for the ball to be delivered, steps upon an electrical intercepting plate, connected by wires with the trigger of the cannon. The speed with which the ball is thrown is regulated by compressed air and prong-like projectors from the cannon's mouth impart a rotary motion to the sphere when discharged, producing a curve in any direction according as the position of the projecting prongs is changed. One serious defect that will prevent its use in games is the long time required for reloading. On account of the frequent delays but three innings could be played. The pitching gun was moderately successful. Eight strike-outs, one base on balls, one wild pitch and four safe hits was the record of the machine.

Proposed Electrical Exposition.

It is proposed to hold a Pan-American electrical exposition on Cayuga Island, near Niagara Falls, in 1899. Cayuga Island is not within the limits of the city of Niagara Falls, but it is not far distant, and by mentioning it in connection with the Falls its location is well defined. The project has been before the public through various announcements for some little time, but now the promoters of it state that their plans are maturing so that their permanent organization will be soon formed. Capt. J. M. Brinker, president of the Niagara Falls & Lewiston Electric road, is at the head of the scheme, and he has interested several prominent men, among them General Superintendent Edgar Van Etten of the New York Central, who can do much to make the project a success. It is the idea of the promoters that the exposition shall represent and display the progress made during the last century, and especially is it designed to portray the progress made in the electrical field. So far as possible the power and light used on the grounds will be furnished by electricity generated in the great power houses at the Falls, and in every way will the progress of the century then closing be compared with the past by apparatus and fixings.

The desirability of Cayuga Island as a location for such a great exposition as is proposed will be well understood when it is stated that the trains of the New York Central, the West Shore, the Michigan Central, the Lake Shore & Michigan Southern, the Lehigh Valley, the Canadian Pacific, the Wabash, the Erie, the Rome, Watertown & Ogdensburg and the Grand Trunk railroads pass within 200 feet of the island on their regular runs. In addition to this the cars of the Buffalo-Niagara Falls trolley line pass still closer, while, as the island is located in Niagara River, a safe distance above the Falls, steamboats from the great lakes can land their passengers right on the exposition grounds.

Electrical Newspaper Troubles.

On June 11th application was made before Judge Freeman in the Superior Court at Chicago for the appointment of a receiver for the *Electrical Journal*. The proceedings were instituted by A. W. Stevenson against the Electrical Journal Publishing company, J. Allan Hornsby, J. D. Jones, V. Merriman, J. P. Barrett and H. H. Hornsby. On June 12th Judge Freeman entered an order appointing Richard A. Lingane receiver upon filing bond in the sum of $1,000. A memorandum on the order contained the information that the proceeding was instituted for the purpose of winding up the affairs of the corporation. The city directory does not contain the name of A. W. Stevenson, and the only person corresponding to the name of the receiver is R. A. Lingane, whose occupation is given as clerk in the post-office.

Under the heading of "Business Troubles" the New York *Sun* of June 19th contained the following announcement:

The W. J. Johnston company, publishers, of 253 Broadway, has applied to the Supreme Court for voluntary dissolution of the company, and Justice Beekman yesterday set September 23d as the date for the order to show cause. The liabilities are $3,420 and the assets $8,930.

New Central Station Company in St. Louis.

Preliminary organization of the Imperial Electric Light, Heat & Power company of St. Louis has been effected, and eventually, it is said, the company will have capital stock of a million dollars to do the business indicated in the corporate name. A large plant will be erected at the corner of Tenth and St. Charles streets under the engineering supervision of Bryan & Humphrey. The Edison three-wire low-tension system will be used, it is said, and all wires will be underground. Current will be furnished, it is expected, by January 1st, next. A feature of the business, as proposed, will be the sale of steam for heating purposes to buildings in the vicinity of the plant. It is said that the new company proposes to make an aggressive bid for custom, including that of the city. The officers are: President, Charles Boettcher, who is also president of the National Bank of Commerce of Denver; treasurer, D. H. Dougan, also of Denver; secretary and general manager, E. G. Bruckman.

An extension of time in which bids will be received for the lighting plant of the city of Eldon, Iowa, has been decided upon. The bids will be opened on July 6th at 1 P. M.

Telephone News from the Northwest.

[From the Minneapolis correspondent of the WESTERN ELECTRICIAN.]

The Willmar Telephone Exchange has been incorporated in Willmar, Minn., with $20,000 capital stock. A local exchange will be put in.

The Standard Telephone & Electric company of Madison, Wis., has issued a map showing the long-distance lines in Wisconsin using that company's instrument.

Jesup, Ia., now has telephone connection with practically all of Buchanan and Blackhawk counties.

Alderman Kiichli of Minneapolis proposes an ordinance annulling all ordinances relative to telephone franchises in the city. This is a stab at the Northwestern Telephone Exchange company, which pays no gross earnings tax under its present franchise. The Mississippi Valley Telephone company, which is an applicant for a franchise, declined to have a provision for a gross earnings tax in its franchise because the Northwestern does not. Kiichli therefore proposes by annulling all franchises to make them apply for new ones in which such a tax will be provided for. It is also believed that he is hostile to the Northwestern company.

The Mankato, Minn., City Council has declined to extend the franchise of the North Central Telephone company for putting in an exhange any longer. The Blue Earth Valley Telephone company of Winnebago City, Minn., which has connection with Mankato, will probably put in an exchange.

The suit of the Kaufman Construction company against the Marshall Telephone company of Marshalltown, Iowa, for $11,000 alleged to be due on a contract for installing an exchange was decided in favor of the defendant.

F. P. Crocker, who has been superintendent of the Wausau Telephone company of Wausau, Wis., has resigned.

A telephone line from Dassel, Minn., to Kingston will be built at once.

J. D. Hills of Menomonie, Wis., contemplates installing a telephone exchange in Eau Claire, Wis.

The Cedar Rapids & Marion Telephone company will extend a line to Ely, Western and Shueyville, Ia., at once.

The Western Electric Telephone company has been incorporated at Albert Lea, Minn., with $50,000 capital stock.

The Standard Telephone company has its exchange at Decorah, Ia., about completed and the Iowa Telephone company has just announced a cut in rates to $12 for a business house and $9 for a residence per year. A four-party line is $6 per year to each subscriber. The Standard company's rates are $15 and $10 for business houses and residences.

The Minneapolis Council committee has amended the ordinance for the Western Telephone Construction company, to prevent it from securing further conduit rights than are necessary for the telephone exchange.

Charles J. Glidden of the Erie Telephone company, which owns the Northwestern Telephone Exchange company, was in Minneapolis last week. He offered, in an interview, to expose the books of the company at Lowell, Mass., to prove that the company did not make a net income to exceed five per cent., and that its dividends are about four per cent. He invited the appointment of a committee to come down and go over all the books. He thinks the independent companies are doomed to a short life. He was accompanied by Asa C. Russell and Charles E. Adams, also of Lowell and members of the Erie company.

W. A. Hopkins and others of Independence, Ia., propose a local telephone exchange.

The county board of Dane county, Wis., voted $500 to build a telephone line to the poor farm.

O. I. Newtons' Sons of Sparta, Wis., will put in a telephone exchange there.

Curious Effect of an Electrical Storm.

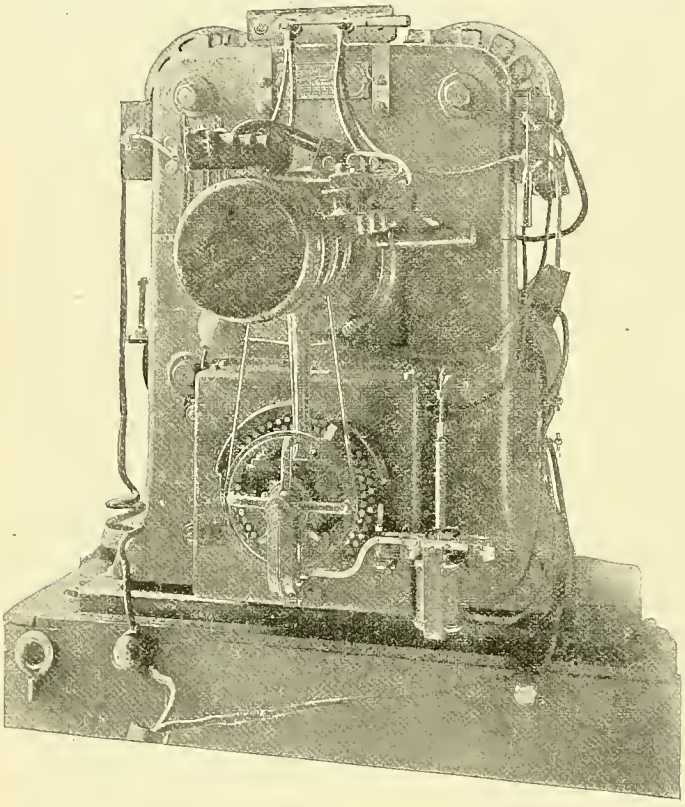
During the storm in Chicago on the evening of June 16th there was a notable electrical disturbance in the atmosphere, with a remarkable display of lightning. One effect was to charge the iron structure of the swing-bridge over the river at Harrison street. This bridge is electrically connected with the return circuit of an electric railway line, and this connection seemed to "short-circuit" the electricity of the air. The *Record*, in its account of the storm, states that George Brown, a driver for Steffel & Santry, 165 West Randolph street, urged his horse out upon the bridge in spite of the blue flames that were playing along the iron rods. The ani-

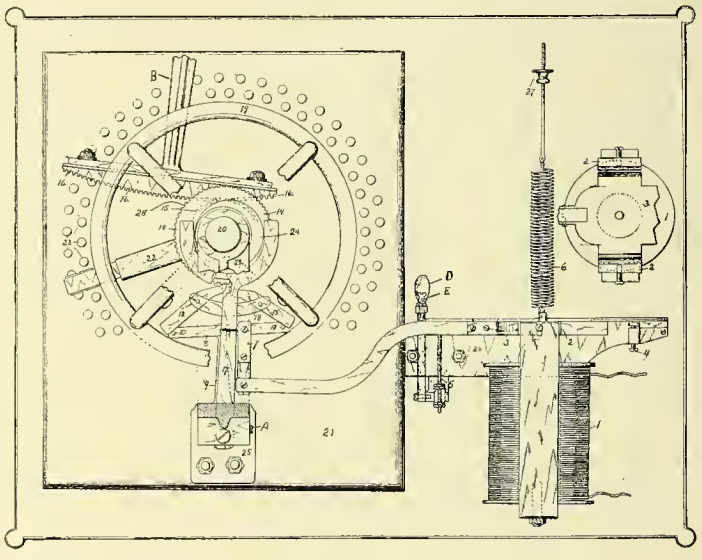
mal was hardly upoo the structure before the electricity leaped up through the iron calks of its shoes and it went down in a heap, stone dead. Brown leaped from his seat and ran away, and the few pedestrians on the bridge at the time made all haste to get away. A fire and police call brought policemen and a chemical engine to the spot. The police had hard work to keep the crowd back. The draw was finally swung open and the circuit broken. During the storm one young man was struck by lightning and instantly killed. Several others were injured, and there was considerable damage to property.

Gartland Regulator for Arc Dynamos.

The following is a description of a new regulator for constant series arc dynamos, especially adapted to the large Brush arc machines, Nos. 9, 10 and 11, but which may be applied to others.

On the Brush arc dynamos the new device is placed in the same position as the present regulator, which is now attached to the rheostat, it being only necessary to drill and tap two three-eighth inch holes into the rheostat case to secure it in position. The regulator consists of but a few mechanical parts, which are operated by a single electro-magnet of new design which is connected in series with the lamp circuit and which throws the combination in and out of action.





FIGS. 1 AND 2. GARTLAND REGULATOR FOR ARC DYNAMOS.

It has no sparking contacts to become oxidized and inoperative, no wall controller, no shunt coils or circuits, and when it is once adjusted to the desired current, it is claimed that it will always remain so, making it unnecessary to interfere with it at any time when starting or stopping the generator, as it is controlled by the current generated in the machine. The combined movements of rheostat and brushes are operated with much promptness that an increase or decrease of about one-tenth of an ampere in the circuit will bring the regulator into action.

Fig. 1 shows the regulator attached and in working order on one of the large Brush machines, while Fig. 2 shows the general arrangement of the regulator, in which *1* is the spool, wound to have a power sufficient to hold the armature *3* balanced in line with the poles *2*, acting of course against tension spring *6*. In this condition the armature is maintained midway between the stops *5;* and the rocking lever *8*, which is connected to armature by connecting link *7*, is maintained in position; this supports the pawls *12* and *13* out of engagement with the ratchet wheels *14* and *14*, and the whole is in a state of equilibrium. If now the current of the dynamo decreases, from increase of load or otherwise, the decreased power of the spool will allow the armature *3* to be lifted by the tension spring *6*, and this will rock the lever *8* and allow the pawl *12* to engage the rachet wheel *14*, as shown in the cut. The constantly oscillating arm *17* will then cause the pawl to move the ratchet *12* toward the right and slightly move the brush rocker the opposite way, and at the same time rotate the gear which meshes with the rack *16*, and this will move the rheostat arm *22*, to which the gear *15* and ratchets *14* and *14* are all three secured together by screws, not shown.

The rocking lever *8* is pivoted on a stand or support *9*, which is vertically adjusted as by screw *A*. On rocking lever *8* are pins *10* and *11* which form seats for the pawls as they slide to and fro. When lever *8* is tilted, the supporting pin departs from pawl, which engages the ratchet wheel *14*. On the other hand, it will be noted that the supporting pin lifts the opposite acting pawl further away from its ratchet. Thus it is impossible for both of the pawls to engage the ratchets at the same time; *18* is a table cast rigidly to the constantly oscillating arm and upon which the pawls are mounted; *21* and *23* pertain to the rheostat. A small belt driven by the armature shaft of generator runs the pulley wheel *19*, which has a rigid eccentric *24*, giving a constantly oscillating motion to the oscillating arm *17*, to which the pawls are attached; *20* is a rigid shaft, on which ratchets *14* and *14*, gear *15* and the rheostat arm *22* are all secured, revolving together by the operation of the pawls; *25* is a bracket fastened to rheostat supporting the mechanical parts of the regulator, but broken away to show parts, while the bracket *26* supports the electro-magnet.

Balancing screw *4* performs but one duty, and that is to adjust the armature *3* to a vibrating balance. Of course this is to be done when the spool is not energized by current and with tension spring *6* unhooked but all the other parts in place. After vibration of the armature is obtained, the wheel *19* is given a few revolutions by hand to ascertain that neither of the pawls engage the ratchets. Should they engage the ratchets, perhaps they are adjusted too close. If found to be in their right position, tension spring *6* is hooked in and adjustment is obtained by threading up on nut *27*, which increases strength of current, while the slackening of tension will reduce the strength of current, this being the only adjustment for increasing or decreasing current. The limit of motion to each of the ratchet wheels is obtained by the omission of one of the teeth on each wheel, the reciprocating pawl traveling between the increased space thus formed, as at *28*. Latch *D* is adjusted by screw *E*, which sets the armature *3* so that neither of the pawls will engage their ratchets, giving free command of the brush rocker by hand until the required strength of current is reached, when the latch automatically releases itself, placing the regulator in operation. The only change which is necessary to place the regulator on a left-hand machine is the connecting of armature *3* to the opposite side of rocking lever *8*.

The application of this regulator for constant potential is in the same manner, the spool *1* being wound according to the electromotive force required. It may also be applied to the regulation of alternating current machines, as well as to separately excited machines generally, by connecting the rheostat in series with the field coils of the exciting machine, and in the case of the alternating machine, preferably connecting the spool *1* in the secondary circuit from a transformer in which circuit a second rheostat operated by a spool in the primary circuit of the alterator is also interposed; this second resistance being so arranged as to give to the spool *1* the same amount of current (and hence of strength) with 110 volts potential around it as at 100 volts, thus automatically taking care of the line loss on primary circuit in exact proportion to the loss, at any and all variations of load. When used to regulate the speed of machinery the arm *B* is connected to any suitable speed governor, and electric current is supplied to the spool *1* from any convenient source.

Chicago Street Railway Properties.

There seems to be considerable doubt among people ordinarily well informed on street railway matters as to the exact effect of the Allen bill upon street railway properties in Chicago. This is probably due to the fact that the bill was rushed through the Illinois Legislature in the hurry always attending the closing sessions and was not held for discussion after amendments had been introduced. These amendments, it might be added, changed the character of the measure completely.

The original bill was in substance a mere amendment to the old street railway act which authorized common councils in cities and town boards where there are no city governments to grant franchises for a term of 20 years. The Allen bill authorized councils and town boards to grant franchises for the term of 50 years. All questions of compensation, fares and of other kinds were left to be determined by the local authorities in granting a franchise. It was provided that all street railway ordinances should be submitted to a popular vote. In its amended form, however, it was a very different measure, the principal provisions being as follows:

The clause providing for a submission of street railway ordinances to a popular vote in cities is stricken out.

No street grant shall be made without the consent of a majority of the "frontagers" on the street. This relates only to new grants. Existing grants may be extended without frontage consents. In case of grants not based on legal consents individual property owners may proceed to enjoin the construction of the roads. At present suits can be brought only by the state's attorney.

The council shall not have power to reduce fares below five cents for the next 20 years. A condition of reduced fares shall not be embodied in any new grant nor in the extension of an old grant. After 20 years the power to reduce fares may be exercised.

The right of consolidation is established, but parallel and competing lines cannot consolidate.

The use of electricity is legalized. Heretofore doubts have existed as to the validity of the ordinances authorizing the change from horse or dummy power to that of

cable or electricity. This question is settled in the amended bill.

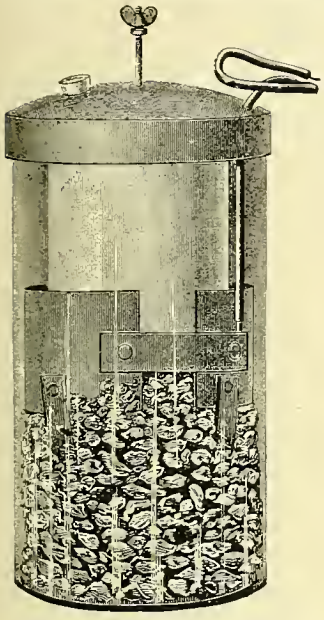
The provision of the Humphrey bill for carrying parcels is omitted. The corporations may use the roads for the transportation of passengers and mails.

Street railway corporations may contract with each other for the joint use of tracks, but no corporation shall have the right to use the tracks of another corporation without its consent.

All questions of compensation for the use of streets and public grounds are left, as in the original bill, to be settled between the cities and the corporations when franchises are granted or extended.

Burnham-Gethins Company's Battery.

The cut shows a complete cell of the Gethins improved gravity battery, made by the Burnham-Gethins company of Boston. It is claimed that this battery is the only form of closed and open-circuit battery that is successfully used for charging storage batteries for small power, such as for running dental engines, X-ray apparatus, surgeon's cautery, mouth and nose lamps, electric pianos and organs, sewing machines,



BURNHAM-GETHINS COMPANY'S BATTERY.

phonographs, etc. The company has a large number of these storage battery outfits now in use, many of them put in operation five and six years ago. It takes considerable pride in showing a number of fine testimonials received from customers who have been using the goods during the past eight years. The writers of these letters include prominent surgeons, physicians and dentists, superintendents of fire-alarm and police telegraph service, college professors, weather bureau officials, numerous city electricians and many others who have thoroughly tested the Gethins gravity battery and have never found it wanting in time of need. The manufacturers claim not to use any acid, alkali or oil in connection with their battery; consequently there is no disagreeable odor or fumes, and no harm done should any of the solution get spilled for any reason. They use simple blue vitriol, zinc and copper for the elements, but, owing to the peculiar arrangement, a very high efficiency is said to be secured, together with long life. The rubber cover prevents evaporation and creeping of salts, so that the battery remains clean and requires almost no attention during its life of from six to 18 months. Six pounds of bluestone are used at a time. The electromotive force is 1.1 volts, and two amperes are given on short-circuit. At a discharge rate of from 60 to 100 milliamperes the cell is stated to be good for 700 ampere-hours.

W. W. Burnham of the Burnham-Gethins company is an experienced hand in the battery business. Mr. Burnham is a son of the late Col. L. W. Burnham, and was with the Electric Gas Lighting company of Boston for 15 years, and was manager for four years of that time. He severed his connection with the old company last April, associating himself with James L. Gethins, well known as the inventor of the Gethins battery cell. The new company devotes itself to the battery business in all its branches, and its office is at 181 Tremont street, Boston.

Necedah, Wis., is considering propositions from several electric light concerns for putting in a plant.

Electrical Power in Sacramento Railroad Shops.

The recent completion of the long-distance transmission line between Folsom and Sacramento, Cal., has placed it within the power of the Southern Pacific Railway company to use motors in its shops at Sacramento, Cal., with most satisfactory results. In operation the motors have already shown considerable economy over that by the original steam plant which they superseded. The motors are placed in the shops where steam engines had previously been used, and the difference between the results obtained, apart from the mere question of economy, is marked.

Three motors are used—the first, a direct current motor placed upon a transfer table used for shifting the locomotives. The motor is similar in every respect to those used on the ordinary trolley car, and is driven by 500 volt railway current from the station. It is so geared that it operates not only the table, but also drives a drum carrying a wire cable used to haul the locomotives upon the table. This it does with perfect ease,

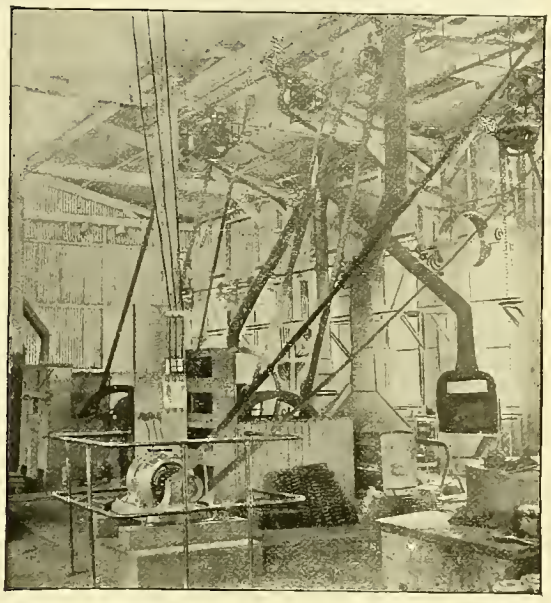


FIG. 2. ELECTRICAL POWER IN SACRAMENTO RAILROAD SHOPS.—INTERIOR OF SPRING SHOP OF SOUTHERN PACIFIC RAILWAY.

hauling all sizes of locomotives. Instead of taking the current from the overhead wire by means of a trolley, the conductors are laid in an underground conduit and the contact is made by means of a plow running in this conduit. Some fears were at first expressed as to the result in rainy weather, but although considerable rain has fallen since the installation of this motor, no difficulty has been experienced. The transfer table and motor are shown in Fig. 1.

The motor used to operate the machinery in the boiler shop as well as in the tender shop is a 50 horse power motor driven by a 440 volt current from the step-down transformers. The machinery in these shops is peculiar, in that each machine is provided with a heavy fly-wheel for carrying it over the sudden shocks which occur in punching and shearing and similar work. For three or four minutes the motor has an excessive amount of work thrown upon it in starting the machine from idleness and until the maximum speed is acquired. The load then drops down to 30 horse power. Such sudden drops as this are very trying to motors of ordinary construction. With the induction motor the drop in the load is hardly noticed.

Fig. 2 shows the interior of the spring shop, driven by a 10 horse power motor. This motor also has to cope with sudden heavy loads. In this shop all the springs—spiral, elliptical and leaf—used in the construction of locomotives, etc., are made, and the most difficult piece of work done is the making of the spiral springs, some of which come to the machine as a bar of red-hot iron 1¼ inches in diameter. This, placed in the machine, is instantly wrapped around a mandril, and it is such work as this that throws for a few seconds an enormous load on the motor. Although it has been in use for some time it shows no sign of strain.

The two motors last named are of the General Electric company's three-phase induction type, without commutator, collecting rings or brushes. They are driven by 440 volt, three-phase alternating current from the transformers, which step down the 11,000 volt current transmitted 24 miles from the generating station at Folsom. This installation is only one of many made

PARAGON FANS AT THE CONVENTION.

since the completion of the transmission from Folsom to Sacramento, which latter city is rapidly becoming dependent on electricity as its exclusive motive power.

Paragon Fans at the Convention.

The accompanying cut, made from a photograph taken at the recent National Electric Light association convention at Niagara Falls, shows the general appearance of the very handsome exhibit of the Paragon fans that attracted so much attention there. During convention time this pyramid of fans was kept in full motion and made such a breeze in the room that it was positively uncomfortable to remain in front of it any length of time. One feature of the exhibit that does not appear in the picture is the highly ornamental appearance of the fans. This exhibit received the highest possible compliment through President Samuel Insull of the Chicago Edison company. Mr. Insull purchased on sight this entire exhibit, and a recent interview in Chicago with Charles Holmes, purchasing agent of the Chicago Edison company, reveals that within a few days after the purchase almost the entire number of fans in the exhibit had been sold. Incidentally Mr. Holmes stated that "the fan motor business has never been better, and

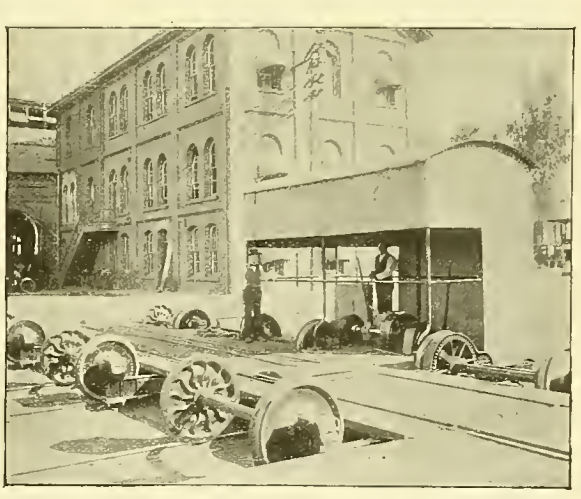


FIG. 1. ELECTRICAL POWER IN SACRAMENTO RAILROAD SHOPS.—TRANSFER TABLE OF SOUTHERN PACIFIC RAILWAY.

the Chicago Edison company's Adams street supply store is disposing of fans in large quantities."

This Looks Like Prosperity.

[From the *Chicago Evening Post.*]

The current number of the WESTERN ELECTRICIAN gives good evidence of the return of prosperous times to Chicago and the country at large. It contains just 80 full pages of advertising and in other respects also is highly creditable to Chicago.

An Electrical Engineer on Trusts.

During the examination of talesmen for the trial of the officials of the American Tobacco company charged with conspiracy, Joseph H. Choate sought to ascertain their views upon the subject of combinations of capital in industrial enterprises and the effect upon the community. One of the men questioned was Charles E. Knox, an electrical engineer, who was graduated from the School of Mines in 1892. He had not read much about trusts, but he had a clearly defined opinion on the subject of combinations of capital. He did not think that this would interfere with his judgment as a juror, although Mr. Choate tried to make him admit that it would. He defined a trust as a "combination of people in a similar line to reduce expenses and increase profits," whereupon the following examination took place:

Q. Isn't that the object of every combination in trade? A. Yes

Q. To make all they can and do all the business they can? A. I suppose so.

Q. Doesn't the Edison Electric Light company acquire all the patents it can and do all the business it can to the detriment of other people? A. I suppose so, but I have no prejudice against the company.

Q. Do you exercise an option in your own business to labor for whom you please, and do you claim a fair price for your services? A. Yes.

Q. You have a conviction against too great an accumulation of capital by a corporation or an individual? A. I have.

Q. Have you any conviction how large a share one person or corporation should be allowed to acquire? A. No.

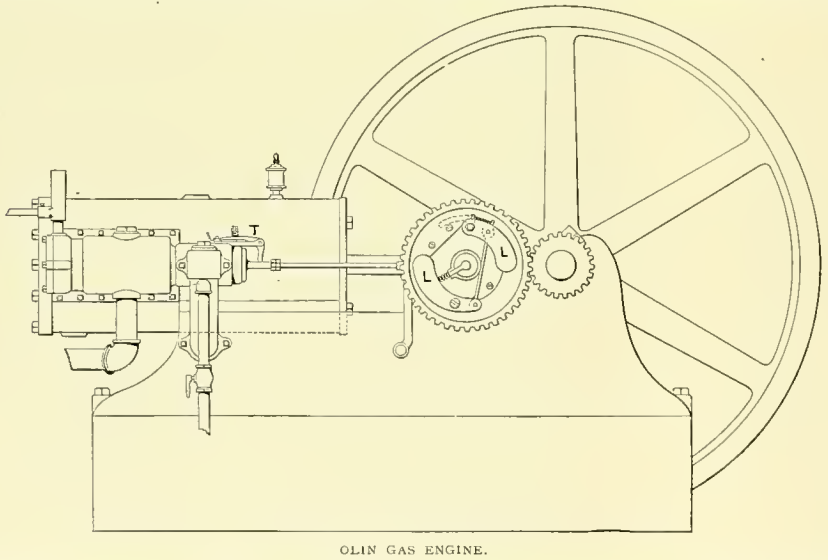
Q. Do you think you could remove your prejudice on the trial? A. Yes.

Q. By what process? A. I should try to be fair.

Q. Do you think you would come out of the trial converted against combinations of capital? A. Hardly.

Olin Gas Engine.

By the cuts are shown a plan diagram and side elevation of the type of engine made by the Olin Gas Engine company of Buffalo. This engine is said to produce a horse power hour with from 10 to 15 feet of good gas or a pint of gasoline. It is simple in construction, and either the electric spark or hot-tube method may be used for ignition. The four-cycle principle is used in operation. The governor is located in the large gear and is actuated by two weights evenly balanced. By its construction the weights are kept in constant motion upon their pivots, so that the friction of quiescence or rest is eliminated, and as its only function is to indicate whether a charge is to be taken or missed, the result is a governor of perfect sensitiveness. The variation of speed by a



OLIN GAS ENGINE.

constant throwing off and on of a full load cannot be detected, it is said, except by the most delicate instruments. The speed may be regulated while the engine is in motion. The manufacturer states that one man can readily start a 25 or 30 horse power engine, and that with larger sizes self-starters are furnished. First-class material and workmanship and the development of the rated horse power are guaranteed.

It is said that the Consolidated railroad people are so well pleased with the electric service between Hartford and New Britain, recently installed, that the third rail will probably be extended to Bristol, a few miles further away from the capital of Connecticut, before many months, although immediate steps to that end are not looked for.

COMMUNICATIONS.

Duty on Mica.

To the Editor of the WESTERN ELECTRICIAN:

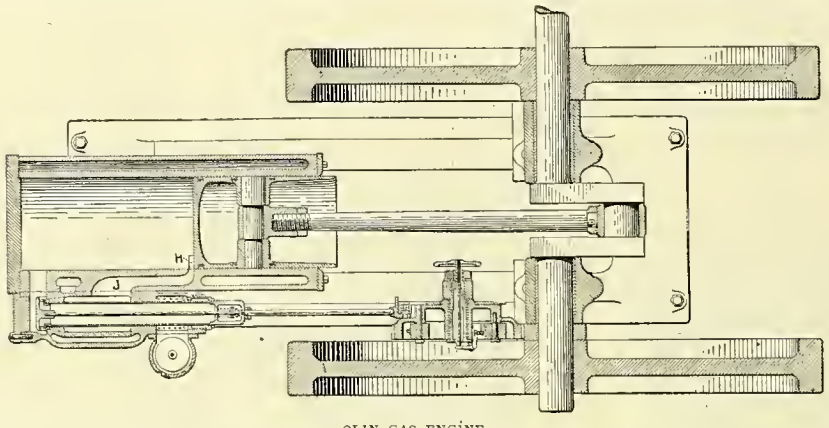
Reading over the discussion about the tariff on mica in a late number of the *Congressional Record*, amazement at the want of knowledge upon the subject, as a whole, on the part of our legislators is the feeling that dominates one who has happened to have a close connection with both the production and consumption of this remarkable article.

The general refrain is that mica is too cheap, that if we could only increase the cost of mica three or even five-fold the country would be richer, that if we could stop the importations profitable mines would be opened up in almost every state in the Union. Is this the truth? From my own experience I am convinced it is not. The true cause of the low price of mica is the fact that the supply greatly exceeds the demand. And even at the present low rate of prices the material is looked upon as a necessary evil, on account of its cost, by every consumer, and the tendency is to use pieces as small as possible. The smaller the piece used the greater the labor entailed; so in all cases an equilibrium has to be struck, which balances the price of the mica with the subsequent labor. If the price is increased smaller sizes will be used, and *vice versa*. If the price is reduced large sizes can be used, and, what is of greater importance, owing to the over-supply, larger quantities also.

Everyone knows that mica varies greatly in its properties, especially in hardness and transparency. North Carolina and Dakota mica and mica from other states stands at the head in combining these two properties—excessive hardness and perfect transparency—and this mica has nothing to fear from competition with that of other countries. It will always command a fair price, and, if the consumption is not interfered with, the mining industry in the states concerned will be in a healthy condition. The consumers of this quality of mica are the stove manufacturers, the makers of lamp chimneys, shades, etc., and, to a limited extent, the electrical manufacturers. Although the electrical manufacturers use this kind of mica where its qualities are required, the bulk of their supply happens to come both from Canada and India. Both countries possess mica of exceeding softness, the quality which is absolutely necessary for them, and Canada with its high-priced labor successfully competes with India, and so would this country if it only had the proper quality. This soft mica has not been discovered in this country, and the electrical manufacturers must have it at any price, and no electrical engineer in his senses would think of using a hard mica where a soft one was essential. He would rather use a substitute, such as paper or fiber, which may be said to rank as the next best practical insulator. Paper at three cents, mica at 19 cents—a pretty bedfellow, to be sure. Any increase in the price of mica is certain to result in a decreased consumption, and it is to the interest of everyone in the mica business, whether he be a miner or importer, that the price of mica be as low as possible. The increased sales at a low price will more than offset the small sales with a large profit.

Whatever tax is put upon the mica imported from other countries will not increase the price of mica mined in this country. There is already an over-production. It would increase the price of soft mica imported from Canada and India, and there would be a stronger tendency than there is now for the electrical manufacturers to use different substitutes.

The electrical manufacturer has scoured the world over to find a suitable cheap mica for his purpose, and the present duty of 20 per cent. is a severe tax upon his business, and the question of using mica is always before him. If from any cause the price is greatly increased a great blow will be struck at the mica business, and the miner, whether he be in Dakota or India, will equally suffer. It will not only be the miner, however, but the electrical manufacturer also. There is no business in the country which has brighter prospects of sending its product abroad than that of the electrical manufacturer.



OLIN GAS ENGINE.

Only the other day one of them secured contracts in England and Australia entailing an outlay of over one million dollars. In fact they are now looking forward to their export business as their chief outlet, and any tax upon them, when competing with England or Germany (and the one on mica is about the only one), might result in a loss of foreign business to the amount of millions of dollars. Mica, by the by, has played no unimportant part in securing these contracts. Owing to its large use American insulation stands very high abroad. This debate about mica in Congress shows a general pressure put upon the various representatives for a higher duty on mica. This pressure has come from those who own a bit of land with mica upon it. They are not in a position to know if a duty would help them or not. I most emphatically say that it would not. The remedy is a greater demand, not a higher price.

I may be like one crying aloud in the wilderness, but for the benefit of the miners, the thousands of men and women who are employed in working the mica after it has been mined and for the mica business generally, I trust these few words will have a hearing.

CHAS. W. JEFFERSON,
Manager Mica Insulator Company.

New York, June 18, 1897.

The Enclosed Arc Lamp.

To the Editor of the WESTERN ELECTRICIAN:

In the paper on "Recent Progress in Arc Lighting," read on June 9th by Prof. Elihu Thomson at the Niagara Falls convention of the National Electric Light association, much space is naturally devoted to the discussion of the enclosed arc lamp. Professor Thomson remarks that "the enclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons." He also claims to have made some experiments in this field in 1879, and adds that "for many years after that date (1879) there were not to be found such pure carbons as would give so little deposition as is required to work an enclosed arc practically."

I am much surprised that one so well posted in the state of the art as Professor Thomson should ascribe the success of the enclosed arc to the "ability to secure very nearly pure carbons." As pointed out in my recent paper read before the International Electrical Society at Paris, in January of this year, the history of the development of the enclosed arc is the record of a succession of failures up to 1894, when, as a result of my work, the first successful enclosed arc lamps were put on the market. The commercial enclosed arc lamp is only three years old. Of the thirty odd thousand enclosed arcs now in successful operation in this country, nine-tenths have been installed within the last two years. Was this phenomenal growth due to the discovery of a pure carbon? Inasmuch as practically the same grade of enclosed arc carbon as is now extensively used was to be found in the open market at least five years before the advent of the successful enclosed arc lamp, the sudden rise must have been due to another cause.

As Prof. Thomson has remarked, and as pointed out by me in my Paris paper, "the idea of burning an arc in a practically closed and relatively small glass chamber is quite old." But the idea of operating a high potential

arc within an inclosure and maintaining the arc with a small expenditure of current is, however, new. Although years before I had used very nearly pure carbons in my investigations with enclosed arcs, still the experiments resulted in failure after failure until the idea of the high-potential arc was evolved by me. This method of operation, an account of which was first given to the National Electric Light association at the Washington, D. C., convention in February, 1894, involves an essential principle of all practical enclosed arcs and marked the beginning of the commercial enclosed arc lamp industry.

As a contribution to the history of the art, Prof. Thomson's reference to his unsuccessful experiments in this line is interesting, as is all that comes from his pen; but it is quite clear that the successful introduction of the enclosed arc system was not due to his efforts.

New York, June 14, 1897. L. B. MARKS.

Electrical Equipment of the Alley "L."

Workmen are now engaged in tearing down the existing coaling station and sheds on the site of the future power house, at Fortieth and State streets, of the South Side Elevated Railroad company of Chicago. Six of the company's passenger coaches have been shipped to Schenectady to be equipped with General Electric motors and the Sprague system of motor control, under the supervision of Frank J. Sprague, who is now on his way home from Europe. These cars will constitute a six-car train, with motors under each car, which will be exhaustively tested to determine the practicability of Mr. Sprague's idea that the cars can be independent motor units and still operated by one motorman on any car when coupled into a train. On the result of this test will hinge the application of Mr. Sprague's system to the train-operation of the road.

Another innovation proposed for this road is the use of open cars. A car of this description, said to be the first open coach ever built for service on an elevated road, is now being constructed for the Alley "L" at the Pullman shops. Though the car will not be "open" to the same extent that the summer cars used on the surface lines are, it will be very much different from the closed coaches now operated by the "L" roads. It will be built on a plan which will permit it to be closed up in winter. The idea which led to a determination to give the open car a trial on the Alley "L" was altogether the result of an accident, says the *Chicago Chronicle*. Some time ago a fire in the Alley "L" yards at Fortieth street damaged a coach so badly as to necessitate its being sent to Pullman for new upper works. A Pullman company official, speaking to President Leslie Carter of the South Side company, said: "By the way, let me make that burned coach over into an open car of some design. It may make a hit and show a way to popularize summer patronage of elevated roads." Mr. Carter gave his consent. The practicability of open elevated cars can be tested as well with one car as with 20, and if this one carries much more than its share of passengers it is altogether likely that next season will find more than one open car operating on the Chicago "L" roads.

Banquet of the Y. M. C. A. Electrical Club.

On Friday evening, June 18th, a pleasant dinner was enjoyed by the members of the electrical club organized a short time ago by the electrical classes of the Young Men's Christian association. The club now has a membership of nearly forty young men interested in the electrical business, and since its organization has conducted a series of interesting and instructive meetings. Practical talks on "The Telephone," "Storage Batteries," "How to Get a Start in the Electrical Business," and "Experiences Abroad" have been given by club members and others, and excursions have been taken to the plants of the Chicago Edison company, the Chicago Telephone company, the Board of Trade and the Auditorium Hotel. Saturday afternoon visits to some of the large power houses about the city and other points of interest are being planned for the summer.

Following the banquet of last week toasts were responded to upon "An Electrifier," "Bugs," "Pounding Brass," "The College Man," "The Practical Man," "Switches," "Our Club" and other subjects, and a thoroughly good time was had. One of the features of the evening was the illustrated menu card designed by one of the club members.

Preparations are already being made for an extension of the class work in electrical subjects for next season, and with the help of the club the Young Men's Christian association, with its home-like clubrooms, promises to become a center of interest for young men connected with practical electrical subjects.

A Circus Horse Electrically Illumined.

An English paper describes the electrical equestrienne performance of Mdlle. Rosina. This lady appears in the ring, which is otherwise in darkness, with both herself and her horse outlined with miniature electric lamps, which give sufficient light to enable her to go through her performance of juggling, etc. There are 35 lamps on the horse and lady, each of 12 volts. There are six cells, each giving about two to 2.25 volts, carried in the saddle of the horse, and each cell measures 13¼ inches by 4 inches by 9 inches high, and weighs six pounds six ounces, so that the extra weight carried by the horse is only a little over 38 pounds. Mr. Sharman, the performer's husband, had some difficulty in getting anybody in England to undertake to supply the cells to weigh under 40 pounds and at the same time to give sufficient output to keep the lamps brilliant during the turn. However, eventually Mr. Ellison undertook the job, and after six months' use the cells appear to be still in perfectly good condition. Mr. Sharman carries about with him a seven ampere, 20 volt dynamo and a small gas engine, for charging the cells, so that he is always independent of any outside supply for his current.

Electricity in France.

At the last general meeting of the Syndicat Professionel des Industries Electriques, the president, M. F. Meyer, quoted some interesting statistics as to the progress of the electrical industry in France. At the end of 1896 there were 428 central stations in the provinces in France, with an aggregate plant capacity of 51,300 horse power, while in Paris the figure was 25,000 horse power, making a total of 150,000 horse power if private and isolated plants be also reckoned in. There are 19 towns with electric railways, with a total track mileage of nearly 200 miles, representing some 10,000 to 12,000 horse power. Statistics of the Ministry of Commerce had shown that during 1895 533 tons of electrical machines had been exported in a finished state and 178 of machine parts. The imports were, however, 745 and 204 tons respectively. In the manufacture of arc lamp carbons and incandescent lamps the balance was on the other side; 39½ tons of carbons had been imported, against 282 tons exported, and there were 20,500 incandescent lamps imported, while 35,000 were exported.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 19.—A new thing in trolley outings is the "century run." An excursion of this character was given by Manager McAdoo of the Paterson (N. J.) Railway company and Vice-president David Young of the Consolidated Traction company a few days ago in one of the Paterson company's new cars, over a portion of the lines controlled by the consolidation. The party left Paterson shortly after 10 A. M., and proceeded to Passaic, where more guests were taken on. Thence the car sped through a beautiful stretch of country to Newark. There a transfer to the Orange lines was made, and at the Essex club in West Orange dinner was served. Quick time was made back to Newark, and thence a run was made to Elizabeth. After returning to Newark the party was taken to Jersey City over the turnpike route. From Jersey City the trip continued to Bergen Point. A clambake supper was served at the Point, and about 8:30 o'clock the car started for Jersey City. At Jersey City Junction the car was switched to the Plank Road line for Newark. It was 11 o'clock when Paterson was reached.

The development of practical electrical science will be illustrated in the next American Institute fair by exhibits. The old American Institute, now in its seventieth year, is aggressive in its announcement of a long show at Madison Square Garden, to run from September 20 to November 4, 1897. The American Institute rooms are at 111-115 West Thirty-eighth street, but the general superintendent, until the fair's close, will maintain an office at Madison Square Garden. It was the American Institute which in one of its fairs first demonstrated to the doubting world the practicability of Morse's electric telegraph and other lesser but important electrical inventions. The managers of the 1897 fair would be pleased to see the electrical section made, if possible, the most important of all the fair's departments, appreciating as they do the importance of applied electricity. The electrical section will include telegraphs, telephones and their construction, signals and alarms, electrical medical and surgical apparatus and instruments, motors, electric lighting devices, and models of or apparatus and instruments used in electrical processes. All inquiries for information regarding exhibits should be addressed to Alfred Chasseaud, general superintendent of the fair, at Madison Square Garden, New York city.

General Manager David Young of the Consolidated Traction company says that the company has under consideration a plan for establishing a pleasure park on a large scale in Hudson county, N. J., similar to the People's Traction company's park in Philadelphia. The project is to purchase a tract of about 30 or 40 acres either in Bayonne or on the northern end of the county, and establish a place of amusement which will be accessible to the public all the year round. The plan is to have a bicycle track, toboggan slides, skating lake, merry-go-rounds, and facilities for all kinds of innocent amusement.

The rival electric railway companies on Staten Island have been clashing again, and there has been wire-cutting, car collisions, arrests and counter-arrests. The trouble relates to the common use of about 2,000 feet of track in West Brighton, and appears to be still unsettled. M. S.

From Old Virginia.

RICHMOND, June 19.—The Pulaski Town Council has granted a franchise to the Pulaski Electric company. The franchise gives exclusive control for 25 years and provides for 17 arc lights of 2,000 candle power, five to be furnished free and 12 to be furnished at a cost of $72 each per annum for 10 years or more. A telephone franchise has also been granted to Langham & Hull. Both of these corporations are to be ready to accommodate the public within six months from July 1st.

The Richmond Common Council has set July 8th for the consideration of the ordinance to grant the telephone franchise to the American Telegraph & Telephone company of Virginia, to do both a local and long-distance telephone business in the city of Richmond. This ordinance did not pass the committee without a hard fight and it is probable that the Council will also deliberate over the matter as fully as the importance of the subject demands.

The Portsmouth Street Railroad company having made a satisfactory contract with the city, work will be commenced very soon. The company claims that it has plenty of money with which to complete the road.

The street railway company at Norfolk expects to go before the supervisors and ask the right of way through Brighton and Prentis place, and if this is secured Norfolk will soon have two fine electric roads.

E. C. Hillyer, president of the Peninsula Electric Light & Power company, has announced that the company has started up the day current for the summer for its patrons who use fans and motive power.

At Alexandria two policemen have had to be detailed to ride on all electric trains passing up and down King street to keep boys from "catching on."

The Bell Telephone company is now stringing wires at Salem, and expects to have the exchange there in operation very shortly.

At a meeting of the Harrisonburg Electric Light company the usual semi-annual dividend of three per cent. was declared.

The new ordinance requiring the telephone and telegraph companies to put their wires underground is now in force, and some interesting complications are looked for. Y. P.

Buffalo and Niagara Falls.

NIAGARA FALLS, N. Y., June 19.—The management of the Buffalo & Niagara Falls electric railroad is giving the subject of shortening the time of the round trip from Buffalo to the Falls considerable attention and study. Commencing June 14th a change in the route was made whereby 7½ minutes were saved in running each way, or 15 minutes in the round trip. Other changes are in contemplation whereby a still further saving of an additional 15 minutes will be effected. "We are doing well now, but we are going to do better," said President Ely.

The Buffalo aldermen have granted the Cataract Power & Conduit company an extension of six months' time in which to supply 10,000 horse power to consumers in the city of Buffalo, which under the franchise the company should have been prepared to do by June 1st.

The triumphal progress of Niagara power still continues. The latest contract announced is one under which the Cataract Power & Conduit company of Buffalo will furnish 1,250 electrical horse power generated at Niagara Falls for the operation of the Great Northern elevator, the immense new grain-handling plant which is being built by President Hill of the Great Northern Railway company and the Great Northern Steamship company in Buffalo. This elevator is to be one of the largest in the world, and power from the big dynamos at the Falls, 25 miles away, will operate it. The conduit system will be extended to the elevator.

The Niagara Falls Power company has awarded all

the contracts necessary for the completion of the extension of the deep wheelpit and power house extensions. As has been announced, the wheelpit is being extended by E. D. Smith & Co. of Philadelphia, the new 5,000 horse power generators are being built by the Westinghouse Electric & Manufacturing company of Pittsburg, Pa., and the 5,000 horse power turbines will be built by the I. P. Morris company of Philadelphia. One of the latest contracts awarded was that for the structural steel, which was placed with the New Jersey Steel & Iron company. Still later the contract for the masonry was awarded to R. D. Young of Niagara Falls, and the contract for the carpenter work to Braas Brothers of Niagara Falls. When completed the capacity of the station will be no less than 50,000 horse power. The tunnel of the Niagara Falls Power company will still have sufficient capacity to discharge the water from a duplicate plant, and the company also has the right to construct another tunnel of equal capacity, while on the Canadian side of the river franchises are held for the development of 250,000 horse power, and yet there is to be added to this the thousands of horse power being developed by the Niagara Falls Hydraulic Power & Manufacturing company.

The Flushing Gas & Electric Light company of Flushing, N. Y., has been incorporated with a capital stock of $300,000. The directors are Charles Whitehead, Fred J. Witt and B. Franklin De Frece of New York.

On Friday, June 11th, Governor Black, ex-Senator David B. Hill of New York and a distinguished party from Rochester visited the central station of the Niagara Falls Power company at Niagara Falls.

D. N. Long of Niagara Falls has thrown quite a bomb into the gas circles in Buffalo by offering to supply acetylene gas for lighting the various county buildings at 50 cents per 1,000 cubic feet used. This offer was made to the supervisors' committee on the purchase of supplies, and is being considered by them. They were about to recommend a five years' contract with the Queen City Gas company at 80 cents per 1,000 feet. As acetylene gas gives a much brighter light than coal gas, Mr. Long's offer is considered much better than 50 cents per 1,000 for coal gas. Mr. Long has invented a generator for acetylene gas which he has installed in several places. O. E. D.

Northwestern Notations.

MINNEAPOLIS, June 19.—The Board of Fire Inspectors has appointed F. D. Varnum assistant electrical wire inspector in St. Paul, but he will not commence work until July 1st.

The Supreme Court has held the Western Union Telegraph company and Dr. H. A. Lathrop of Marshfield, Wis., to be guilty of libel in transmitting a message reading thus: "The people of Wisconsin have demonstrated you an unscrupulous liar," to Rev. I. G. Monson. It arose out of an election contest in which the Rev. Mr. Monson opposed the candidate of his party. When the candidate was elected, Dr. Lathrop, in the enthusiasm of the moment, sent the objectionable dispatch. The case went up to the Supreme Court on the overruling of a demurrer, which was sustained, and the case will be tried on its merits. The only thing to be determined is the amount of damages.

A stock company has been organized in Chatfield, Minn., with $50,000 capital stock to establish an electric lighting plant. Joseph Underleak is president.

The city of Antigo, Wis., is in darkness, the electric lighting contract having expired, and the council refusing to renew on the old figures. The people want 15 additional arc lights, but the company will not make the reduced price nor the extensions desired.

F. J. Thrun has made a proposition to put in an electric light plant at Eagle River, Wis., if the waterworks plant is leased to him and he is paid $2,800 per year for operating the water works and furnishing electric light. As this is less than the waterworks plant is costing alone, it is probable that the proposition will be accepted.

The Chippewa Valley Electric Railway company of Eau Claire, Wis., is having routes for an extension to Chippewa Falls examined. No definite decision has been made in the matter.

The La Crosse Edison Light company, the La Crosse Brush Electric Light & Power company and the La Crosse Gas Light company of La Crosse, Wis., have combined in the same office and will be under the joint management of C. H. Greenwood. The three corporations will remain distinct and the move is simply for the purpose of retrenching office expenses.

The Hubbard Milling company of Mankato, Minn., has been compelled by the shrinkage of values to make an assignment. This company furnishes power for the Gas & Electric company, but the assignment will in no way affect the company.

The village of Fosston, Minn., is taking bids until July 5th for furnishing an electric light and water works plant, from plans by C. F. Loweth, civil engineer, of St. Paul.

The city of Marinette, Wis., has come to terms with the electric light company, and the streets are lighted again. The city secures 62 lights at $5 50 for midnight service instead of $6.67 for all-night service as heretofore.

The contract for an extension of the street railway line in Madison, Wis., to Wingra Park has been let to the Falk Manufacturing company of Milwaukee.

An electric light plant is in prospect for Renville, Minn.

The city of Faribault, Minn., has contracted with the Polar Star Electric company for 43 arc lights at $4.25 per month per light for midnight service.

Joseph Hoag of Manchester, Iowa, and William Bauer of Oneida, Iowa, have purchased a three-fourths interest in the electric light plant at Tampico, Mexico, for $26,000 in Mexican money.

The St. Paul Council has passed the Bigelow ordinance requiring the street railway company to change the Selby avenue cable line to an electric from Broadway to Merriam Park, and the ordinance is ready for the mayor's signature.

The sheriff has levied on the plant of the Spencer Electric Light company at Spencer, Ia., and will sell it to satisfy a judgment of $11,000 in favor of the First National bank of Spencer.

The courthouse and city hall commission of Minneapolis has formally accepted the electric elevators put in the building by the Sprague company. There has been much criticism of these elevators, and charges have been made that they were not up to the guarantee of the company. The board has now notified the company that the elevators are in every way what they were promised to be.

At the expiration of the present contract for electric lights in Minneapolis, the successful contractor for the next period will be required to provide testing stations in different parts of the city.

Citizens of Stillwater, Minn., have subscribed funds to purchase the electric railway and operate it, and their troubles were thought to be over, when an injunction was applied for by W. M. Hewitt, to restrain Flint & Scott, the owners, from disposing of the system. Hewitt was formerly receiver for the company, and claims an interest in the profits.

Albert Grapp & Co. have opened an electrical supply house in Waseca, Minn.

A. D. Ellsworth & Son will probably be granted a franchise for an electric lighting, power and heating plant in Cedar Falls, Ia.

The Chippewa Valley Electric Railway company of Eau Claire, Wis., has applied to the Council of Chippewa Falls, Wis., for a franchise, and proposes to construct a line between the two cities.

C. K. Mead, Manager of the Ft. Wayne Electric corporation at Des Moines, Ia., has been transferred to Omaha, Neb., as general manager. His territory will include several states.

A franchise for the Menomonie Electric Light & Power company is being considered by the Menomonie, Wis., Council.

Bids are being taken in St. Paul for an electric light plant for the city and county building.

The Minneapolis Council committee has ordered the street railway company to construct a car line to St. Anthony Park.

The proposed new franchise for the Citizens' Traction company of Oshkosh, Wis., is alleged to give it the right to deal in any business of which electricity is the basic principle, and there has been considerable newspaper wrangling over it, as to whether it does or not.

The Minneapolis Council has adopted the committee report ordering the street railway company to extend a line toward St. Anthony Park as far as the city limits, which, of course, is the limit of its power. Thomas Lowry, president of the company, says that the action of the Council has not made money any easier to get. Then, too, he anticipates that it would be difficult to get permission from the St. Paul Council to construct that part of the proposed line within the limits of that city.

An electric light plant will be installed in the state insane hospital at Rochester, Minn.

The Boone, Ia., Council is considering an ordinance permitting the Boone Electric & Street Railway company to use electricity as a street railway motive power.

Henry C. Payne, the Milwaukee capitalist, recommends to eastern capitalists to build an interurban electric line between Neenah and Kaukauna, Wis. It will involve an expense of $200,000 to $300,000.

The Council of Cedar Falls, Ia., has granted a franchise for electric lighting to Messrs. Leavitt, Gilkey, Bartlett and Grundy, and work on the plant is to be begun at once.

James G. Robinson secured the contract to furnish an engine for the electric light plant in the city and county hospital in St. Paul for $995; John A. Gorman for wiring the building, for $750, and the Western Electric company of Chicago for the dynamo, at $1,105. W. I. Gray & Co. of Minneapolis were the lowest bidders on the dynamo, at $992.

The General Electric company has offered to dispose of its electric light plant in Des Moines, Ia., to the city for $161,000. An expert has examined the plant and reports its value to be $132,727.

The city of Mt. Pleasant, Ia., voted to purchase the electric light plant, thus ending a long struggle with the company.

The city of Negaunee, Mich., is to be in darkness hereafter until the new municipal electric light plant is ready for operation. The contract was let some time ago, but injunctions to prevent its construction have been secured and carried to the Supreme Court. The latter has just affirmed the decision of the Circuit Court permitting the Council to put in the plant. Work has been begun on the plant, and the Ft. Wayne company, which has the contract, has recently had a strike to contend with, the laborers on the power house demanding $1.50 per day. The strike was terminated by the company acceding to the demands.

The schedule of assets and liabilities of the Standard Brass & Electric company of St. Paul, assigned, were: Assets, $2,973; liabilities, $4,007. C.

PERSONAL.

J. S. Crider of the Washington Carbon company made a brief visit to Chicago last week.

Frank F. Kinney, a well-known electrical engineer of Omaha, Neb., was in Chicago during the early part of this week.

H. O. Phillips, treasurer and general manager of the Phillips Insulating Wire company, Pawtucket, R. I. visited Chicago last week.

John S. Maurer, who represents the Crouse-Tremaine Carbon company and the Fostoria Incandescent Lamp company of Fostoria, Ohio, was in Chicago last week.

H. L. Aldrich, business manager of *Marine Engineering*, was in Chicago last week and received many congratulations upon the success which has rewarded his latest effort.

Eugene F. Phillips and F. N. Phillips, president and treasurer of the American Electrical Works of Providence, R. I., spent a few days in Chicago last week in company with F. E. Donohue.

Announcement is made that Paul M. Lincoln, electrical superintendent of the Niagara Falls Power company, is to marry Miss Elizabeth R. Hague of Columbus, Ohio, on Wednesday, June 30th.

I. R. Edmands of the General Electric company has gone West to take charge of the installation of the electrical machinery of the power development at Minneapolis and St. Paul, Minn.

V. D. Greene, who has occupied the position of superintendent of fire alarm of Toledo, Ohio, for several years, has been appointed local manager of the Central Union Telephone company at that point.

W. H. Hornsberger of the Vindex Electric company was in Chicago last week. Mr. Hornsberger has attracted considerable attention by his splendid work in the development and exploitation of the Vindex transformer.

J. Richard Sloan of Chicago has been appointed electrician for the Pullman Palace Car company, with headquarters at Jersey City. Mr. Sloan was a member of the class of '97 of the Armour Institute of Technology, and was graduated by that institution on June 17th. The appointment is considered a compliment to the Armour Institute.

W. Forman Collins of the WESTERN ELECTRICIAN, accompanied by his wife, sailed Saturday, June 12th, from Montreal on the Scotsman of the Dominion line for Europe. Mr. and Mrs. Collins will make their headquarters near London. Their numerous friends earnestly wish them a pleasant trip, and they trust that Mr. Collins' health will be fully restored.

It is proper and fitting to say that the appointment of Edward B. Ellicott as superintendent of city telegraphs is in large measure due to the untiring efforts of John Valentine and Ernest L. Clark in his behalf. Mr. Ellicott did not make a personal canvass, but the gentlemen

named espoused his cause with enthusiasm, circulated a petition asking for his appointment, and secured such a showing of names that the mayor did not hesitate to make the appointment at the proper time. The list was a noteworthy one; it represented electrical and other substantial business interests, and there wasn't a politician's name on it. Messrs. Valentine and Clark are entitled to congratulations.

ELECTRIC LIGHTING.

The congressional sundry civil bill provides for an appropriation of $65,000, to be immediately available for an electric light plant for the United States postoffice building at Washington, D. C.; also an appropriation of $24,000 for lighting the United States capitol and grounds.

The consolidation of all the electric light companies operating south of Thirty-ninth street, with the exception of the People's will be effected, it is said. The proposed combine takes in the Hyde Park, the Thomson-Houston Electric Light company, the Chicago Illuminating company, the Hyde Park Electric Light & Power company and the Englewood Electric. It is said that $750,000 bonds will be issued to retire maturing securities, and provide funds for improvements and extensions.

A newspaper dispatch from Marquette, Mich., runs thus: "R. A. Wilson, superintendent of the electric light plant in this city, is said to have discovered a complete model of an electric lighting plant, made by an inventor named John Ingalls, in 1887. By it a light similar to that of the incandescent bulb is said to be obtained without the use of a filament, the light being caused by waves of electric energy. This invention is essentially the same as that developed by Nikola Tesla, depending on the discharge of oscillating waves in high vacua. His 'glow-lamp' system of illumination has been applied within narrow limits."

ELECTRIC RAILWAYS.

The Baltimore Consolidated Railway company has been organized by the amalgamation of the Baltimore Traction company and the City & Suburban company. The capital stock is $10,000,000, consisting of 400,000 shares, at a par value of $25 a share. The new company will issue $12,000,000 4½ per cent. gold bonds, $10,500,000 of which will be used to retire the divisional mortgages as they mature, the remainder going into the treasury of the company. The mileage of the consolidated company is 185 miles.

It is reported from St. Louis that negotiations for the purchase of three street-car lines, two of which are electric and the other cable, belonging to the Missouri Railroad company, have been closed. Edward Whitaker, president of the Lindell street railway system, and C. D. McLure, one of the heaviest stockholders of the system, are the purchasers. The price paid was between $165 and $170 a share, and several million dollars changed hands. It is presumed that the deal was made on behalf of the Lindell company, and that the new acquisition will be made part of that system, which already covers nearly every section of the city.

Funeral cars will be run on the lines of the St. Louis street railway companies this summer. In the bill introduced in the City Council lately, applying for a franchise to extend the Southern electric road from its present terminus at Broadway and Howard street to the fair grounds, a clause is included authorizing the company to run funeral cars, as well as United States mail and express cars. As yet the company has formed no definite plan for the operation of these cars, and has set no time for the inauguration of this new departure. One or more cars especially constructed for funeral service will be built. It is possible to conduct a funeral in this manner for $10, which would cost not less than $50 if carriages and a hearse were employed.

All current claims against the Calumet Electric Street Railway company of Chicago have been settled up by Receiver John C. McKeon. The requisite cash Mr. McKeon advanced to the road as receiver for the National Bank of Illinois out of the funds of that institution. The $200,000 certificates which Judge Showalter authorized Mr. McKeon to issue as receiver for the Calumet Electric are now in the latter's hands, and an amount of these equal to the amount of cash advanced by the bank has been transferred to the bank's credit. The balance of the certificates will be issued from time to time in settlement of the less pressing claims and for the work of repair and improvement outlined in Receiver McKeon's petition. None of them will be required for payrolls, as the road is earning its operating expenses and something more.

The connecting link in a new line between Chicago and Riverside and La Grange is being completed on Ogden avenue, between West Fortieth and West Forty-eighth streets. The Ogden Electric company, which is building the line, is controlled by Charles T. Yerkes. The Ogden system is intended as a direct feeder to the West Chicago company's down-town lines, and also to the Lake Street "L" line. At present the cars of the Ogden company run on West Forty-eighth street, connecting at Madison street with the Cicero and Proviso cars. By building on Ogden avenue the Yerkes lines cut off two sides of a triangle and secure a direct diagonal route from the intersection of Ogden avenue with the western line of the Ogden company to the down-town district. It will be possible under the new service to take a car at State street and continue the journey to Riverside with a single transfer, the total fare being 10 cents. The anxiety of the officials of the Yerkes companies to get ahead of the Suburban Electric company in tapping the western suburbs comes largely from the announced determination of the latter company to inaugurate a system of graded fares. It is understood that the Suburban company will make a seven cent fare from Austin and Oak Park to and from the city when its electric equipment is completed. As all the Yerkes connecting lines charge a double fare of 10 cents to and from the city the proposition of the Suburban company to make a graded fare is considered the beginning of a fierce competition for traffic to the western suburbs.

TELEPHONE.

The Philadelphia Standard Telephone company, which secured a franchise to operate an independent telephone service, is reported to have entered into a contract with a New York banking firm to raise the capital to complete the work of construction. It is further reported that the work was begun months ago with capital furnished by a construction company, but it was suspended on account of the business depression. The company, it is understood, intends to enter into rivalry with the Bell company and let the courts determine the validity of the patent rights it claims.

TELEGRAPH.

Permission has been refused to the Compagnie Francaise Cables Telegraphique to land the new cable of that company at Cape Cod, or indeed anywhere upon the United States coast. The question that was raised through the French ambassador as to the power of the government to deny admission to the cable will be referred to the attorney-general for an opinion, but meantime the president holds to the doctrine that such landing can only be legally accomplished by express authorization of Congress.

All the plans for a Pacific cable have been changed by the prospect of a treaty by which Hawaii will be annexed to the United States. The Hawaiian government refused to renew the exclusive cable contract awarded to Z. S. Spaulding 18 months ago and which expired on May 1st. The government now professes to be anxious to treat with the first organization offering to make a definite proposition to give the islands cable communication, regardless of national or any other consideration. Information from the Canadian authorities encouraged the hope that Hawaii would form one of the connecting links of the proposed Canadian-Australian system, but with the prospect of annexation to the United States these negotiations will be broken off.

MISCELLANEOUS.

Dr. Lueger, the anti-semitic mayor of Vienna, having secured to the municipality the management of the gas works and lighting of the city, is now working to secure municipal ownership of the principal tramways, and is charged with fomenting the recent strike of the company's employes.

Improvement in the business of the Electric Storage Battery company is shown by the company's annual statement for the fiscal year 1896. It shows gross sales during the year of $646,000, against $328,000 in 1895; operating expenses were $504,000, leaving a profit of $142,000. Added to this is the income from royalty and investments of $7,000, making a total of $149,000; interest amounted to $14,000, leaving a net profit of $135,000. In 1895 net profit was under $3,000.

At least two elevator companies in Buffalo will use electrically transmitted energy from Niagara Falls to operate their machinery. The latest to announce its intention to avail itself of the power is the Electric Elevator company, whose elevator building is now going up on Buffalo Creek. This company will take 450 horse power, and the motors have been ordered. Electricity is popular with elevator establishments because it is less likely to create fires than power generated on the premises.

TECHNICAL SCHOOLS.

The degree of electrical engineer was conferred on one graduate at the Notre Dame University last week.

The natural history hall of the University of Illinois was struck by lightning on the night of June 16th and was much damaged by fire and water. The building will be fully repaired before the opening of the fall term in September.

Professor W. S. Franklin of the Iowa State University, who has been elected to the chair of physics and electrical engineering at Lehigh University, after being graduated from the University of Kansas in 1885, took special courses of study at the universities of Berlin and Harvard.

Of the 441 degrees conferred by Cornell University at this year's commencement, the College of Civil Engineering was allotted 26 and the College of Mechanical Engineering and Mechanical Arts 133. Of the latter number of graduates 74 were in the department of electrical engineering.

The class of 25 which was graduated on June 17th at Rose Polytechnic Institute in Terre Haute, Ind., is one of the largest of the thirteen which have received the institute's diplomas. Only five graduates read their theses. All graduates had prepared theses, which were examined by the faculty.

The library building of the Iowa State University was struck by lightning on the morning of June 19th and destroyed by fire. It was a two-story brick structure, with the library on the second floor and the physical laboratory on the first floor. The total loss will be $100,000. Of this $50,000 was in books, $17,000 in apparatus belonging to the physical laboratory and $33,000 in building. The library was the best in the state. One fireman was caught in the building under a falling roof and burned to death before being rescued. The libraries of the law, medical, dental and scientific departments were uninjured, being in other buildings. The building was an old structure and will probably be replaced with a new fireproof one.

TRADE NEWS.

Alfred B. Clements of the California Asphalt company of New York has been making a western trip, and stopped over a few days in Chicago. Mr. Clements is establishing agencies for his company throughout the West. After visiting St. Louis Mr. Clements expects to return to New York.

By a printer's omission in the copy for recent advertisements of the Chicago Belting company in the WESTERN ELECTRICIAN it was possible to gain the impression, by a hasty glance, that the company was in the hands of receivers. Of course nothing could be farther from the truth than such an assumption. The line of type containing the receivers' names is a part of the photographic reproduction of the letter from the Louisiana Electric Light company of New Orleans, in which the superintendent and general manager speak in high terms of the "largest leather belt in the world" furnished to the Louisiana company by the Chicago Belting company.

The Ball Engine company, Erie, Pa., is building two 125 horse power horizontal tandem compound engines, which will be used for the electric transmission of power and light in a large works in the city of Moscow, Russia. The Langehorne Electric Light & Power company, Langehorne, Pa., has recently increased its electric light plant by adding a 200 horse power engine built by the Ball Engine company, Erie, Pa., being the third engine of this manufacture placed in this plant. The Waiowright Brewing company, Pittsburg, Pa., has recently installed an 80 horse power engine, built by the Ball Engine company, Erie, Pa. The engine is direct-connected to a General Electric dynamo.

Among recent contracts, the Julius Andrae & Sons company of Milwaukee has secured the electrical wiring of the seven-story building of the Goll & Frank company. In this building all wires will be carried in molding specially painted with fireproof paint. The building will be wired for nearly 1,200 lights and for three elevator motors of 20 horse power each. At the main entrance there will be a marble slab with three switches—one main line triple pole, by which the lights in the entire building can be cut off at once by the porter before leaving, one double-pole switch which will shut off the current from all the electric motors in the building, and one double-pole switch which will control all the lights in the office on the main floor. This will be a great convenience, as it will always leave the office supplied with current, whether the main switch is on or off. Many times the bookkeepers will have to work late in the evening, but at the same time they will have the assurance that all the rest of the building is without current. The building will also receive an installation of private telephones between the various floors and offices. The Andrae company also reports many wiring contracts for private residences, hotels and flat buildings in Milwaukee and Berlin, Wis.

BUSINESS.

The Electric Appliance company has been so successful in the introduction of the American electric soldering iron that it is preparing a circular of a few of the many testimonial letters received from customers in regard to the operations of these irons. Many customers have written them that, although they had tried every other soldering iron placed on the market, the American iron is the first one that is a commercial success. The American Appliance company looks for a large sale of these goods, as a satisfactory electric soldering iron has long been wanted.

The Chicago office of the Westinghouse Electric & Manufacturing company has just secured a contract from the Apple River Power company of New Richmond, Wis., for a 250 kilowatt three-phase 6,000 volt inductor type generator. In this contract was also included a number of two-phase motors and a switchboard, transformers, lightning arresters, etc. The company has purchased a water power site of about 700 horse power and will transmit current seven miles to the city of New Richmond, where it will supply the local electric light company, do the city pumping and operate a flour mill. It has also placed a contract for the water wheels, and will begin work within a week or two.

The call among the manufacturers of electrical apparatus for a first-class file has been very marked, and it would seem that this want has been met by the G. & H. Barnett company of Philadelphia, whose famous Black Diamond File Works were established in 1863, and are so thoroughly known that no introduction is necessary. The fact that 12 medals have been awarded this company at international expositions is in itself enough to place the product in an enviable position before the electrical trade. Arrangements are now completed whereby this company's goods can be found in every leading hardware store in the United States and Canada. New descriptive matter in regard to these files can be had upon application.

ILLUSTRATED ELECTRICAL PATENT RECORD.

Issued June 15, 1897.

584,341. Apparatus for Controlling Electric Motors. Bradley A. Fiske, U. S. Navy. Application filed March 6, 1896.

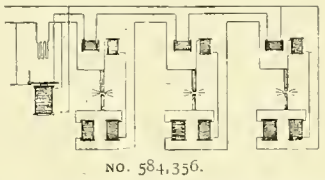
Provision is made for varying the electromotive force of the generator and reversing the current between generator and motor, and mechanism is employed whereby the current-varying and current-reversing devices may be conjointly operated.

584,352. Party Line Telephone System. William H. Harter, Norwalk, Ohio. Application filed August 10, 1896.

At the sub-station there are an electro-magnet having a circuit-closing reed armature in the main circuit, a local battery circuit, the telephone receiver support-arm and an electro-magnet with contact-making armature included in the local circuit, the contact armature being adapted to close and maintain a shunt to the main or line circuit through and including the ordinary telephone bell.

584,356. Electric Arc Lamp. Ignace H. Hegner, Paris, France. Application filed February 4, 1896. Patented in France June 17, 1895.

Two or more arc lamps are employed, and a means for preventing the feeding together of the carbons of any lamp until the resistance of the lamp group has attained the desired amount, and of a means for feeding the carbons of each lamp controlled by the resistance of its own arc.



NO. 584,356.

584,382. Electrical Circuit Closing Thermometer. Alexander Luraschi, London, England. Application filed March 15, 1897.

An adjustable movable terminal is completely inclosed within the thermometer tube, and there is a perforated cross-wire through which the movable terminal passes, the cross-wire being sealed into the sides of the thermometer tube by fusion: and a fixed terminal is always in contact with the mercury.

584,384. Automatic Electric Signal Transmitter. Athol B. Macklin, New York, N. Y. Application filed August 7, 1896.

Separately movable contact devices and a fixed device permanently supplied with battery current, and having separated series of contact points, each series adapted to engage one of the movable devices, are employed.

584,393. Telephone System. Frank R. McBerty, Downer's Grove, Ill. Application filed May 14, 1896.

When a number of telephone circuits are used, including transmitting telephones, and having a common return conductor, two or more sources of current are provided, having different poles connected with the common return conductor, andtheir other poles connected with different circuits, whereby cross-talk in the circuits is diminished or prevented.

584,414. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed April 26, 1893.

An indicator is frictionally connected with a source of mechanical power, and a retaining catch normally engaging with the indicator is controlled by an electro-magnet.

584,415. Telephone Line Circuit. Charles E. Scribner, Chicago, Ill. Application filed August 1, 1895.

The combination comprises a metallic circuit telephone line, a transmitting telephone and a receiving telephone in a bridge at a sub-station, a signal bell in a permanently closed branch from one line conductor, a magneto generator in a branch from the other line conductor, an annunciator at the central station conuected with the line to receive current from the generator, means for applying signaling current to the line also at the central station to operate the signal bell, a source of current adapted for exciting the transmitting telephone at the central station, and means for connecting the source of current with the line, whereby switches at the sub-station are avoided.

584,416. Electro-maguet. Charles E. Scribner, Chicago, Ill. Application filed November 4, 1895.

The combination with an electro-magnet is described, of a bridge of magnetic material between its poles, a coil encircling the bridge, and means for producing current in the coil, the coil being adapted to create a condition of no difference of magnetic potential between the poles of the magnet.

584,417. Telephone Circuit. Charles E. Scribner, Chicago, Ill. Application filed November 4, 1895.

Included in this arrangement are a central supply battery in connection with a telephone line, a bell and a storage battery permanently connected serially in the line at the sub-station, an induction coil, a receiving telephone in circuit with the secondary winding, and a transmitting telephone in circuit with the primary winding, a switch, and circuit connections controlled by the switch adapted to bring the receiving telephone and secondary winding of the induction coil into shunt of the bell, and the transmitting telephone and the primary winding of the induction coil into shunt of the battery.

584,418. Spring-jack for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. Application filed July 20, 1896.

There is the combination with a block of insulating material having a groove in it, of a switch-spring and its anvil strap laid in the groove, the parts being secured together, one of the parts having an inclined lug at one edge, and another of the parts having a laterally projecting lug, and recesses in the block of insulating material adapted to receive the lugs.

584,427. Production of Electric Sparks for Signals or Theatrical Effects. Vladimir Tabulewitsch, St. Petersburg, Russia. Application filed January 16, 1897.

A lamp is employed having an insulated coil secured to the base thereof, a tube having a closed bottom and open top mounted on the coil, and adapted to receive one end of an electrode, and secure the same therein by means of clamps, and means for reciprocating the tube, consisting of a core of soft iron, and a spring-operated lever having a roller on its free end which is adapted to bear against the closed end of one tube, one electrode being composed of carbon and the other electrode being composed of steel, the steel electrode being provided with means to permit a slight longitudinal movement of the same when the electrodes are brougbt togetber, consisting of spiral springs.

584,431. Armature for Dynamo-electric Machines. Henry H. Wait, Chicago, Ill. Application filed February 27, 1896.

Features claimed are rings or disks of laminated material, spaces being provided at intervals between the disks to form ventilating passages, insulating troughs, and armature coils wound within the troughs, ventilating spaces being provided between the troughs and affording communication with the ventilating passages in the armature core.

584,462. Electric Circuit Protector. Alvah L. Creelman, Memphis, Tenn. Application filed August 11, 1892.

Each telegraph station or office is provided with a relay instrument and a key included in the circuit, a local circuit at each station or office containing a battery, sounder and controlling apparatus, each controlling apparatus being adapted to shunt the main circuit around the relay and key in the same office therewith when the main-line circuit remains open for a prolonged time.

584,463. Electric Signal. Alvah L. Creelman, Chicago, Ill. Application filed August 17, 1895.

Two circuits will be established through the relay magnet and one through the alarm apparatus, all including the same battery when the circuit closer is momentarily closed, and whereby only one of the circuits through the relay magnet will be opened.

584,464. Telegraph Sounder. Alvah L. Creelman, Chicago, Ill. Application filed September 3, 1895.

A sounder magnet is located in an electric circuit, a branch circuit, a bell magnet, and electrically operated apparatus in circuit with the sounder magnet adapted to open the branch circuit when the sounder is active, and to close the same when the sounder magnet is de energized.

584,465. Circuit Protecting Sounder. Alvah L. Creelman, Chicago, Ill. Application filed May 18, 1896.

An electrically operated device is included in the main-line circuit for operatively connecting the circuit controller with one of its mecbanisms when the main-line circuit is interrupted for a predetermined time, and means for operatively connecting the circuit controller with its other operating mechanism when the main-line circuit is closed.

584,466. Telegraphic Sounder. Alvah L. Creelman, Chicago, Ill. Application filed July 3, 1896.

The combination is described of an electric circuit, a sounder magnet and a retarder magnet forming a part thereof, a second circuit containing a circuit-changing magnet, a contact carried by the armature lever of the retarding magnet for shunting the current from the first circuit through the second.

584,476. Insulator. Sam H. Libby, Schenectady, N. Y. Application filed February 10, 1897.

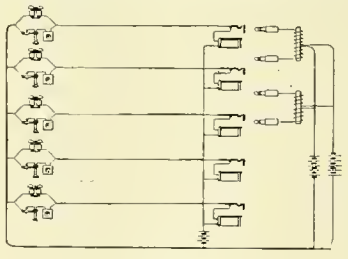
A metal base, a body of insulating material mounted upon the base, a rail clamp secured to the conductor rail and prevented from moving independently of the insulator by frictional engagement therewith.

584,477. Insulator. Sam H. Libby, Schenectady, N. Y. Application filed February 10, 1897.

In an anchor insulator a conductor rail is used with a body of insulating material applied to each side of the rail, a separate support for each insulator, and means for connecting the conductor rail and the insulators together.

584,482. System of Distribution. Edwin W. Rice, Jr., Schenectady, N. Y. Application filed February 7, 1896.

The method of maintaining potential upon a two-wire system of distribution connected with a three-wire system consists in supplying the two-wire system with energy from both sides of the three-wire system.



NO. 584,393.

584,496. Electric Headlight. Frederick W. Dressel, New York, N. Y. Application filed May 12, 1896.

An electric headlight is described, in which are comprised a body having a back and one portion of the rim formed integral, a movable portion of the rim hinged to the fixed portion at one side, and having a holding device at the other side, a reflector and a front plate or lens.

584,511. Electric Railway. Theodore W. Klomau, Montclair, N. J. Application filed April 30, 1896.

A slitted conduit is provided with a stationary rail extending throughout its length; a series of sectional conductors or rails is parallel therewith; a series of stationary contacts is connected to a current feeder or main; a series of movable contacts is mecbanically connected with the sectional conductors or rails, the fixed and movable contacts being inclosed in water-tight switch-boxes; a series of exposed or surface contacts is electrically connected with the movable contacts, and a two-part cup-shaped trolley is rigidly supported by a car or vehicle, and adapted to bear continuously upon the stationary rail and successively upon the sectional rails, the sectional rails being provided with means for restoring them by gravity to their normal position after the trolley has passed from under them.

584,577. Regulating Speed of Induction Motors. Ernst Danielson, Stockholm, Sweden. Application filed May 2, 1896.

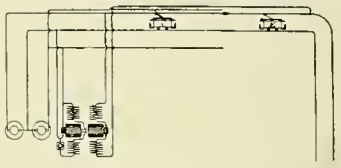
Induction motors are mechanically connected together, the motors having different numbers of poles, and means for operating them singly or in tandem groups.

584,606. Trolley Stand. Sidney H. Short, Cleveland, Ohio. Application filed February 16, 1897.

There is the combination of a base having a slot, a trolley arm support pivoted to the base on a vertical axis, a trolley arm pivoted to the support on a horizontal axis, and a finger rigid with the arm and extended below its axis, and adapted to enter the slot when the trolley arm is in service, but to be withdrawn therefrom when the arm is drawn down.

584,607. Trolley Stand. Sidney H. Short, Cleveland, Ohio. Application filed February 16, 1897.

The first claim is given: The combination of a base having the two slots at diametrically opposite points, and a trolley arm support pivoted to the base on a vertical axis between said slots, with a latch lever pivoted to said support and adapted to engage in either slot, and a trolley arm pivoted to the support and having a finger adapted to engage said latch lever and swing it out of engagement with said slots when the trolley arm is drawn down, and means exerting a constant force to swing the trolley arm upward.



NO. 584 482.

584,618. Telephone Transmitter. Horace C. Alexander, Bonham, Tex. Application filed February 27, 1897.

A telephone transmitter, comprising a diaphragm and shell formed from one piece of metal, a block of insulating material to which the diaphragm is secured, a carbon block attached to a metal plate secured to the block of insulating material, a vibrating nipple on the diaphragm extended into a cell formed in the carbon block, and an electrode of granulated material surrounding the nipple in the cell.

584,632. Lightning Arrester and Multiple Automatic Fuse Block. Gustave X. Gast, New Orleans, La. Application filed April 10, 1897.

A swinging arm makes connection through the fusible strips successively, and an automatic switch throws the current through the resistance during the passage of the swinging arm from the melted fusible strip to the next fusible strip.

584,649 Secondary Battery Plate and Method of Producing Same. William P. Patton, Jersey City, N. J. Application filed February 15, 1897.

The plate is composed of a sheet metal partition coated with soluble inert material on each side, and having openings along the edges, and cast-metal perforated sides which are integrally united through the openings in the partition.

584,694. Increasing Illuminating Power of Electric Arc Lamps. Paul Mersch, Paris, France. Application filed April 14, 1897.

The composition described consists of the admixture of carbonate of magnesia, asbestos or some other incombustible textile product and silicate of potash.

584,700. Electrical Advertising Announciator for Cars. James P. Orr and George H. Fugh, Pittsburg, Pa. Application filed September 29, 1896.

This device is composed of a cabinet, comprising a glass front illuminated to display leaves and other advertising matter with an electric propelling motor comprising six helices, four of which are mounted in pairs with space between, two helices pivotally mounted between the pairs as an electro-magnetic armature, and having arms, a crank shaft and a link connection between the arms and the crank shaft.

584,722. Perforator for Electric Telegraphs. Charles G. Burke, Brooklyn, N. Y. Application filed September 4, 1896.

A feeding mechanism is provided for the strip, a punch or die, an electro-magnet for operating the punch, a series of keys or levers controlling circuits which include the electro-magnet, a series of electro-magnets which operate the keys or levers, a series of automatic circuit closers which control the circuits in which the last magnets are situated, and a series of keys corresponding to letters or figures, and arranged to control the movements of the circuit closers.

584,733. Electric Wire Barbing Machine. William O. Bates and William J. Hutchins, Joliet, Ill. Application filed February 13, 1897.

In the machine described there is the combination with the stationary electrodes and their supporting frame, the operative electrodes, the sliding head and the eccentric and strap thereof for operating the head and electrodes.

584,737. Telephone. Cornelius C. Gould, Philadelphia, Pa. Application filed February 9, 1897.

In a telephone transmitting apparatus, a mouth-piece, a series of nipples secured in a wall thereof, a plurality of transmitters, and a connection leading from each nipple to each of the transmitters.

584,750. Incandescent Electric Lamp. Charles E. Scribner, Chicago, Ill. Application filed April 24, 1893.

This invention comprises the combination with a glass bulb of a metallic cap hermetically sealed thereto, the cap carrying an aperture, an insulating plug within the aperture through which the leading-in wire passes, and a metal ring having its outer edges sealed to the cap, and its inner edges sealed into the plug, the plug and the metal ring being made of material possessing substantially the same co-efficient of expansion.

Western Electrician.

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Vol. XX. CHICAGO, JANUARY 2, 1897. No. 1

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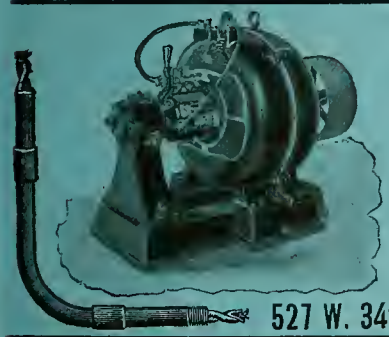

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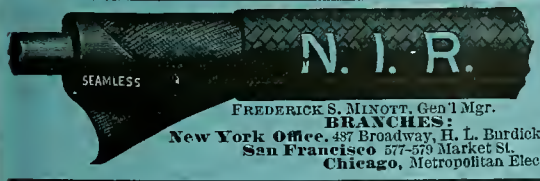

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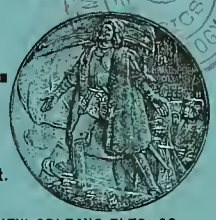

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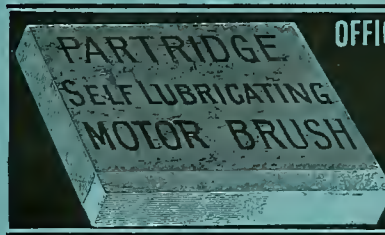

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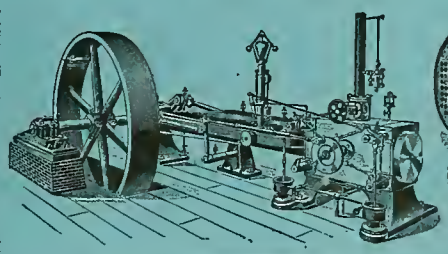

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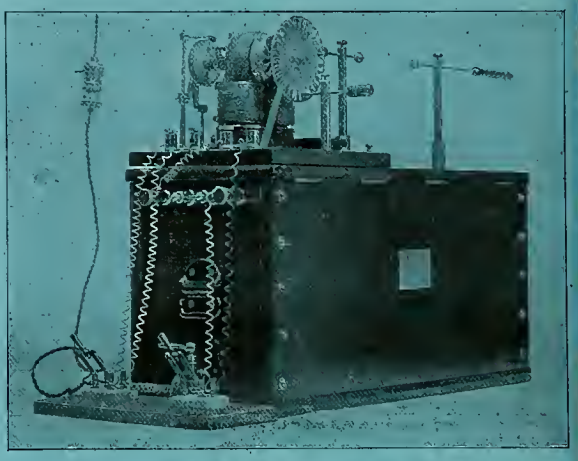

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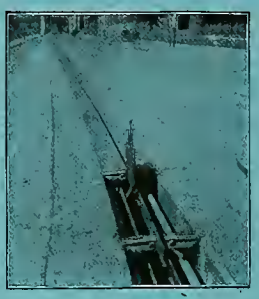

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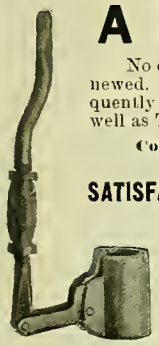

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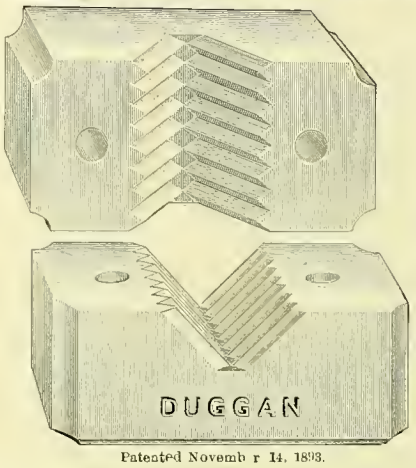

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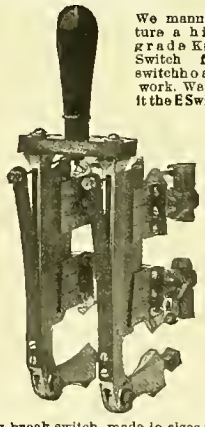

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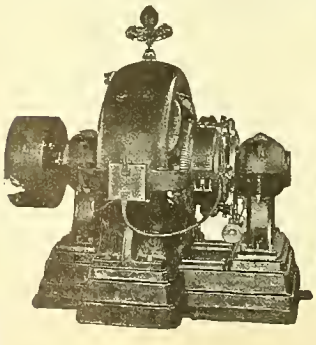

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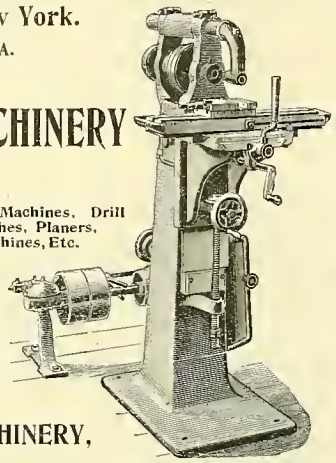

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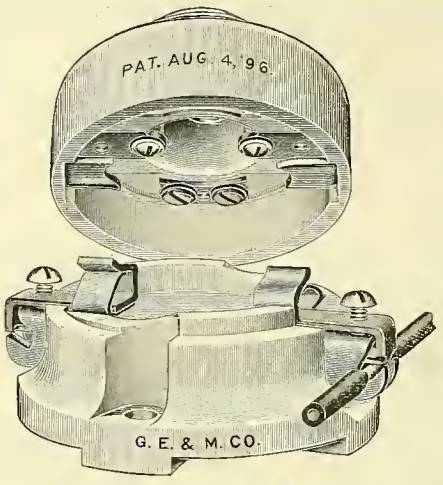

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THAN

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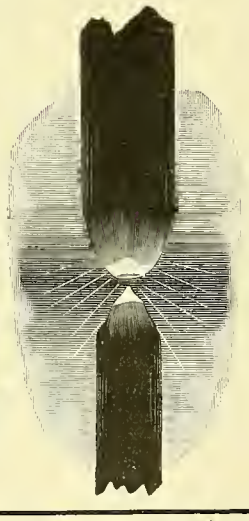

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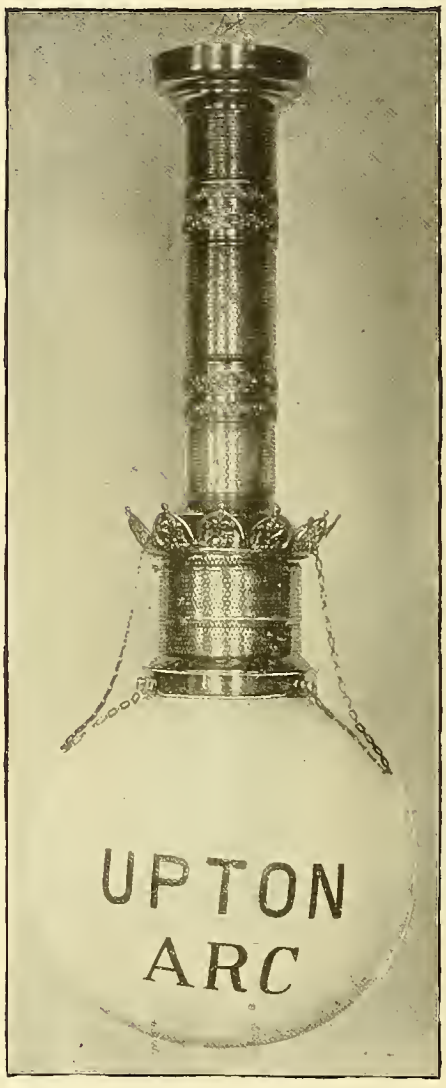

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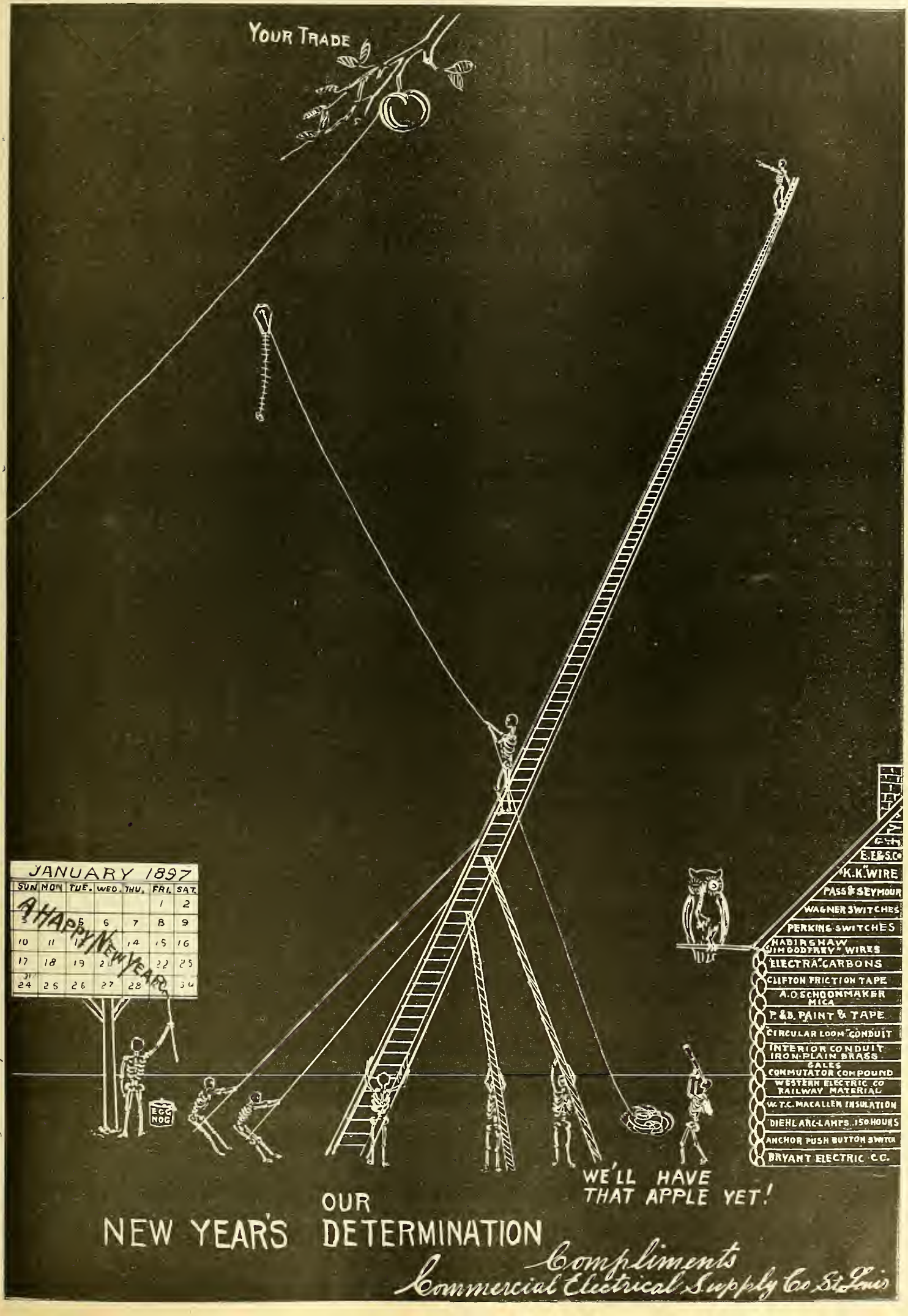
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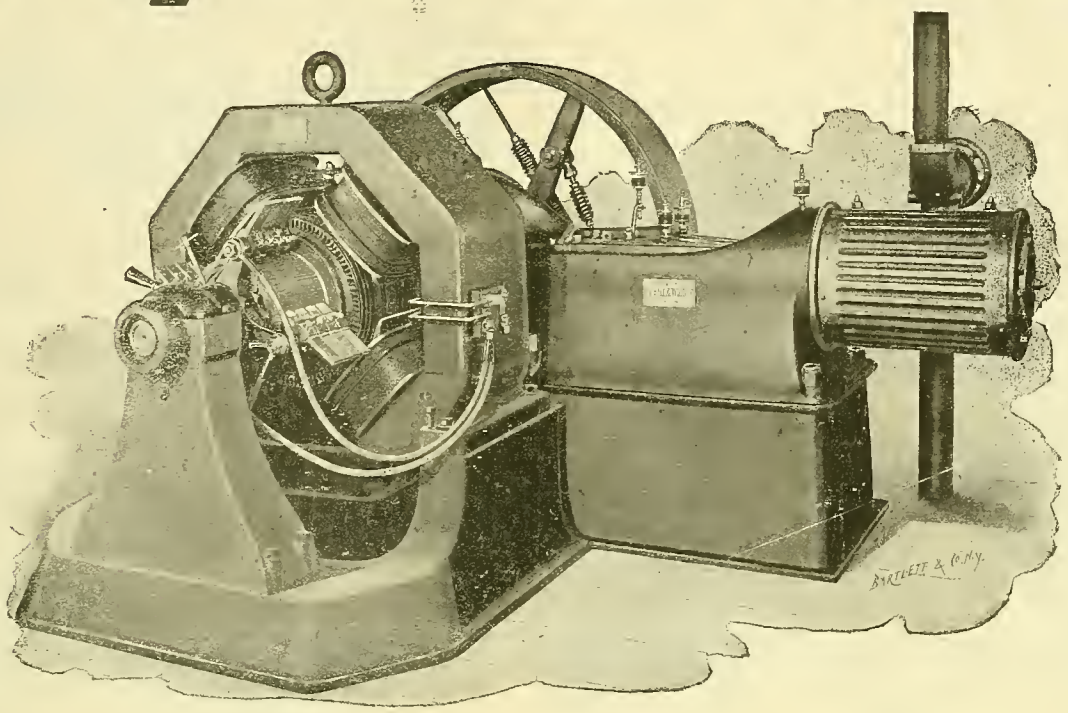

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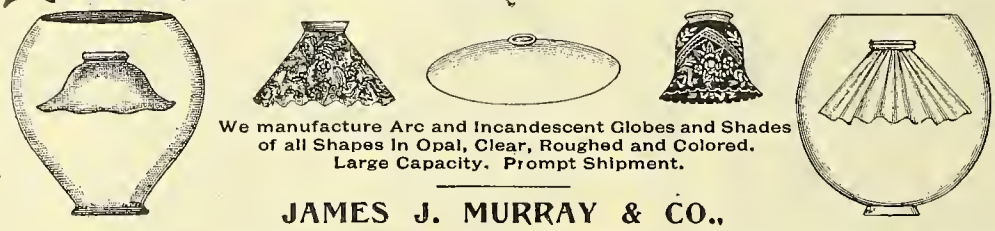

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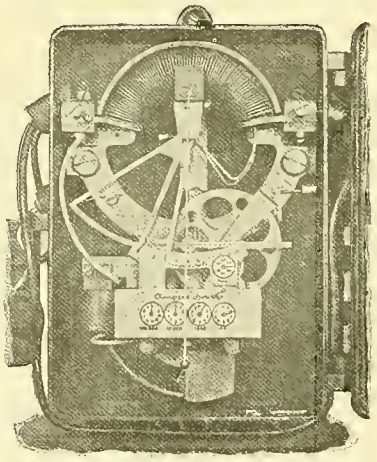

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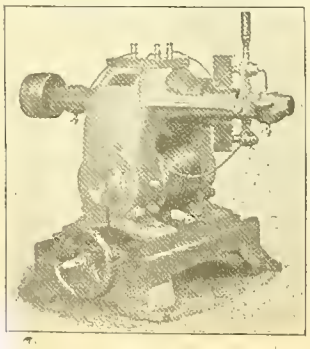

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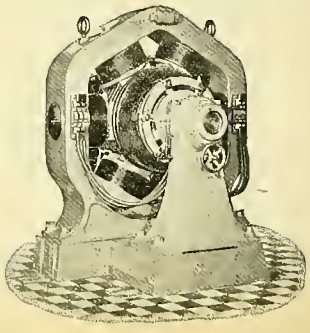

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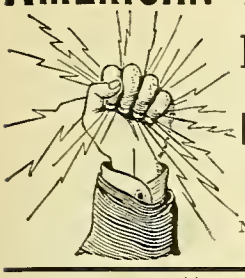

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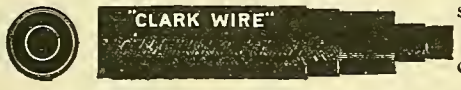

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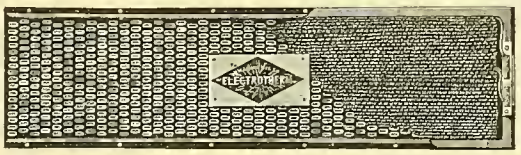

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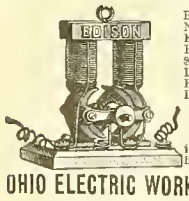

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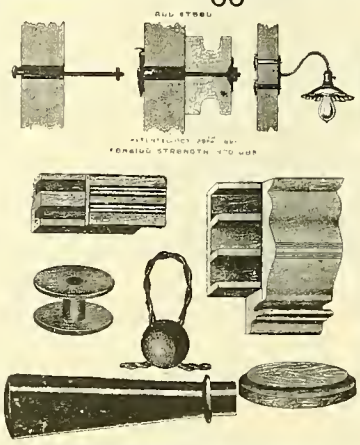

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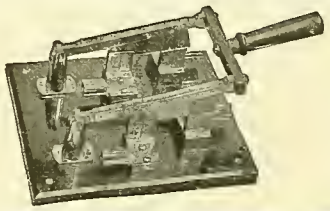

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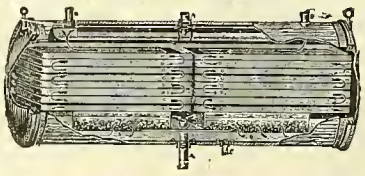

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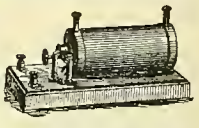

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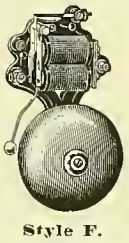

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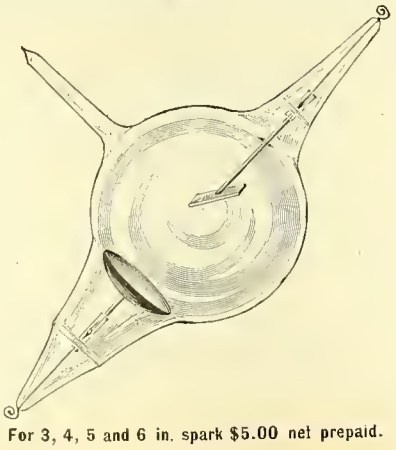

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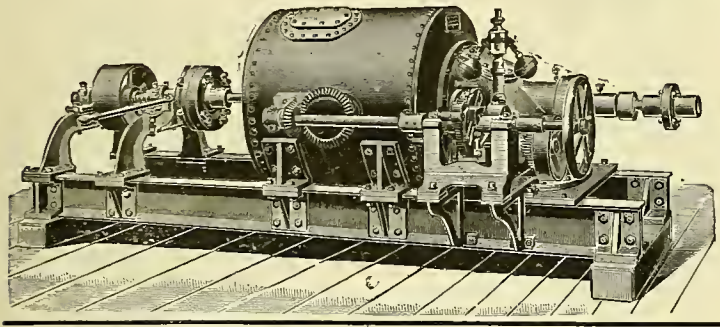

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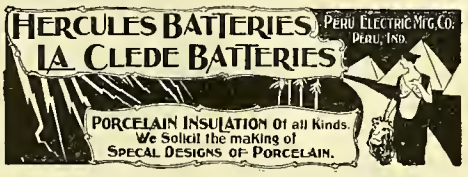

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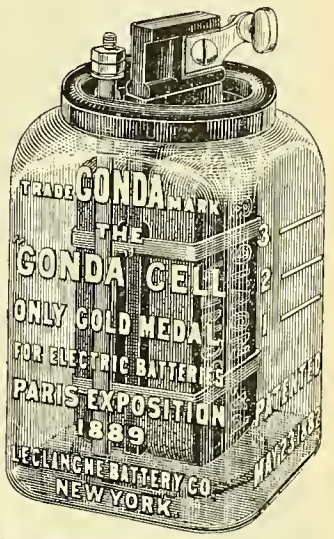

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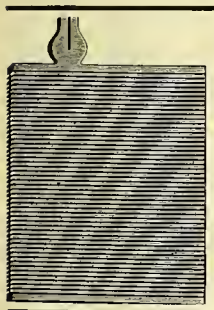

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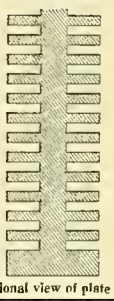

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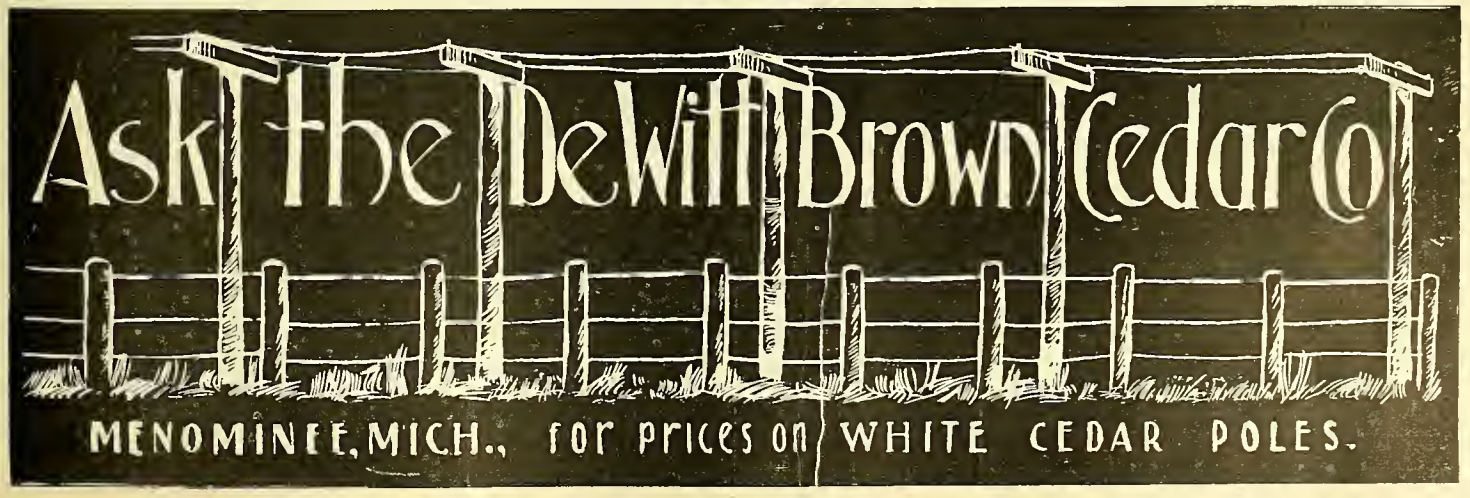

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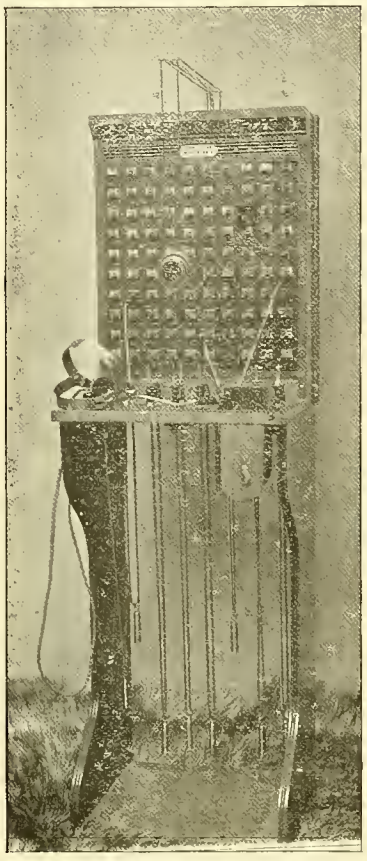

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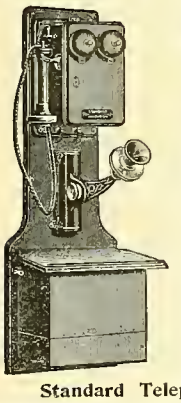

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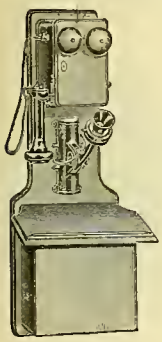

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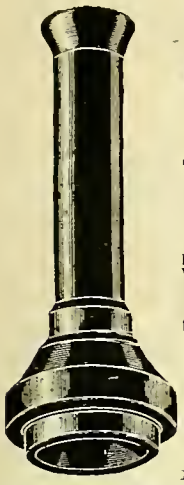

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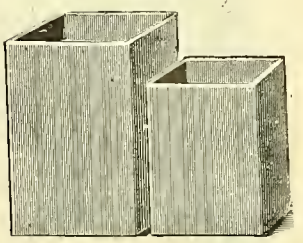

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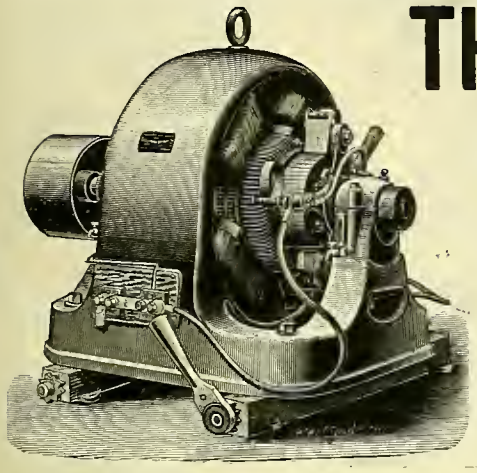

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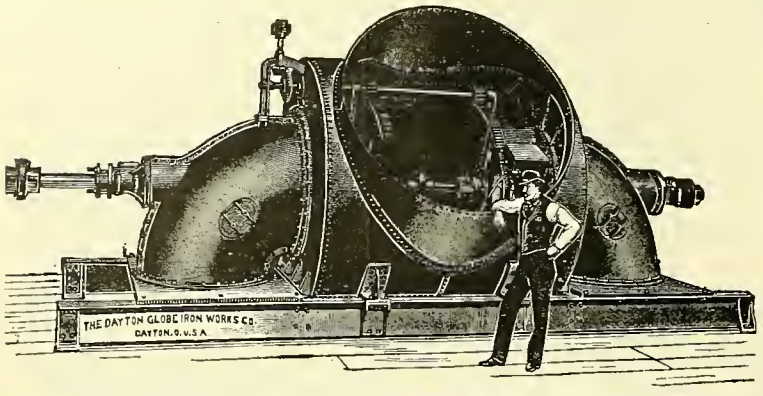

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⅞ "	16.42	122.00	127.18	195.19	82.58
¾ "	16.78	117.33	112.60	175.74	82.18
⅝ "	17.03	111.83	98.12	149.99	79.81
½ "	16.88	118.67	82.07	118.40	75.62

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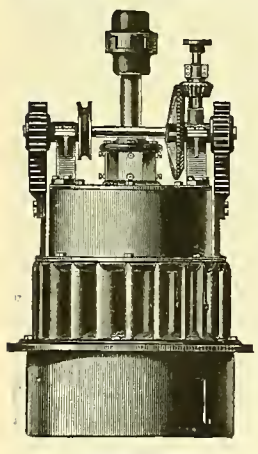

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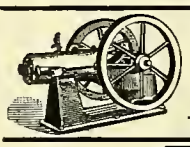

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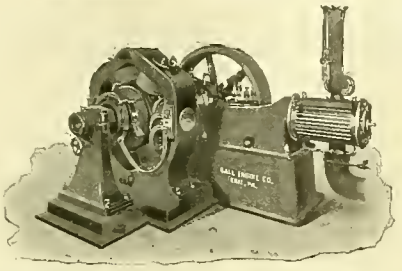

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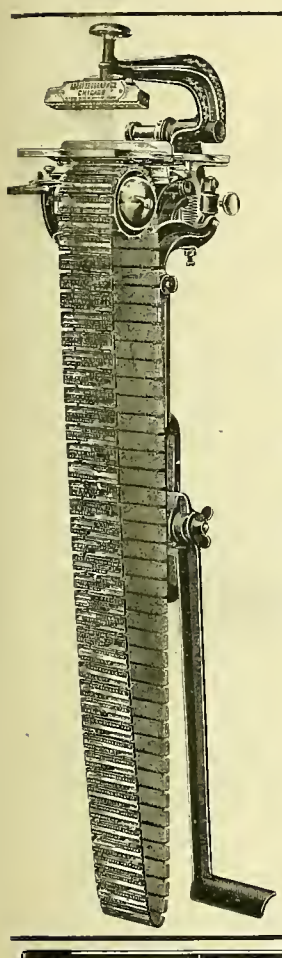

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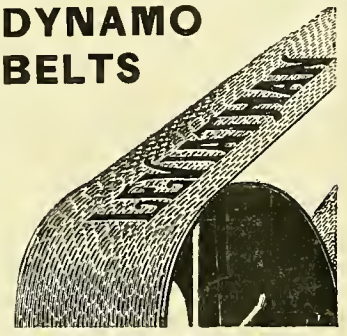

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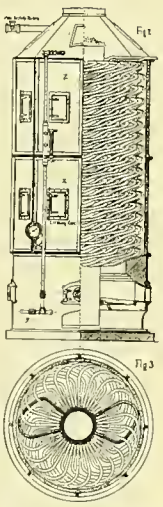

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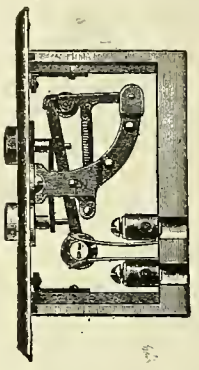

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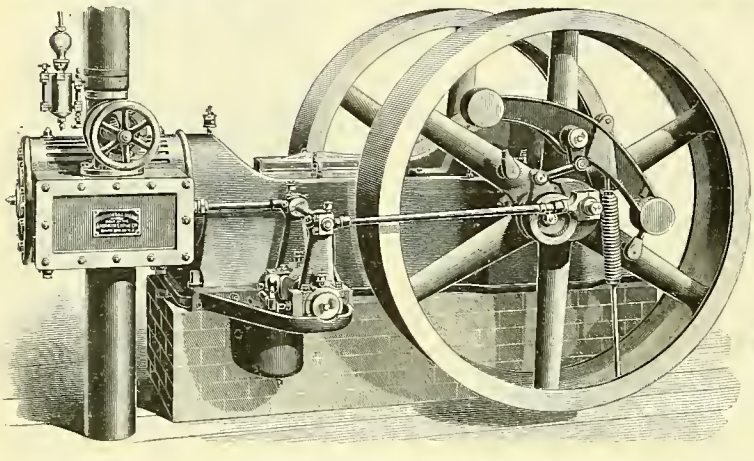

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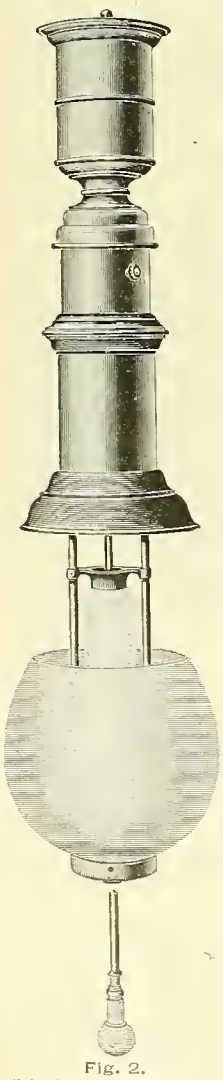

Fig. 2.
Globe lowered for trimming. Globe cannot fall off.

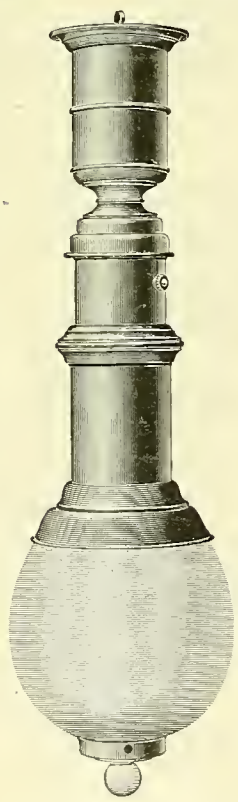

Fig. 1.
Appearance of Lamp when in use.

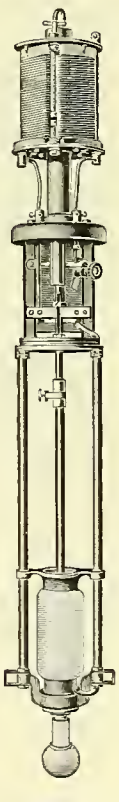

Fig. 3.
Ornamental parts and globe removed.

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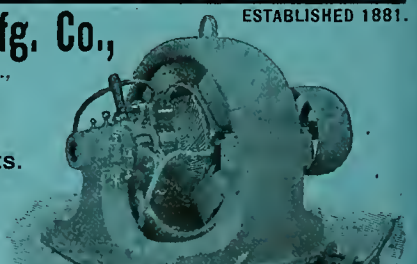

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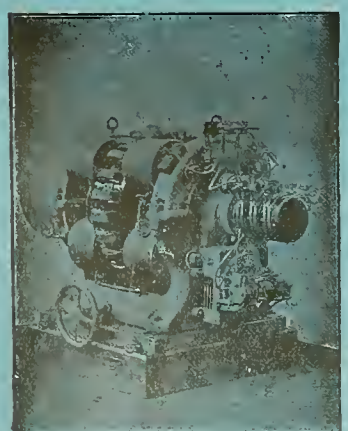

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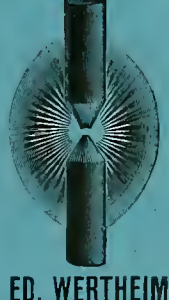

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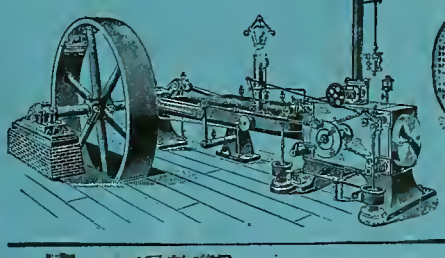

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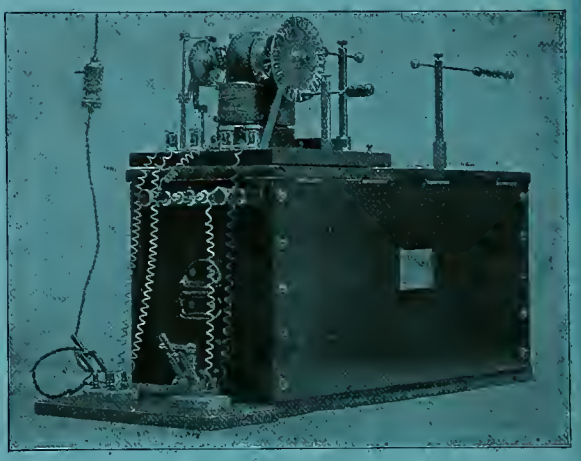

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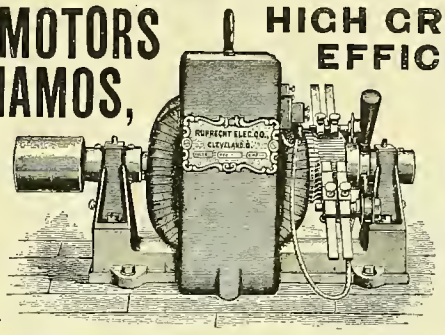

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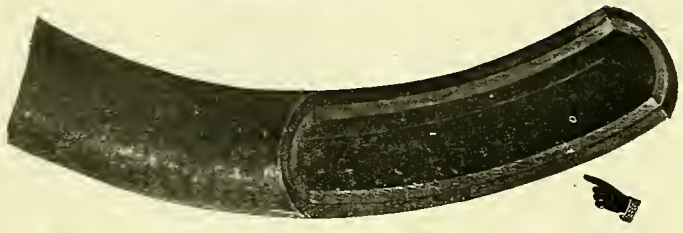

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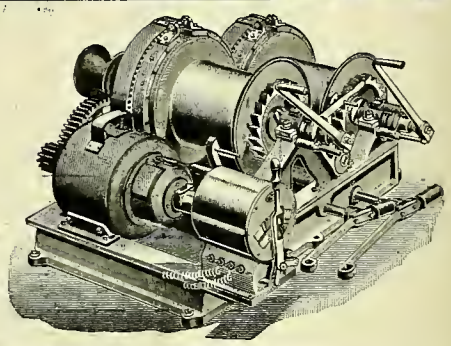

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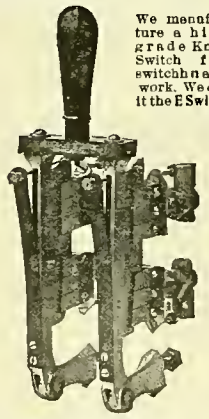

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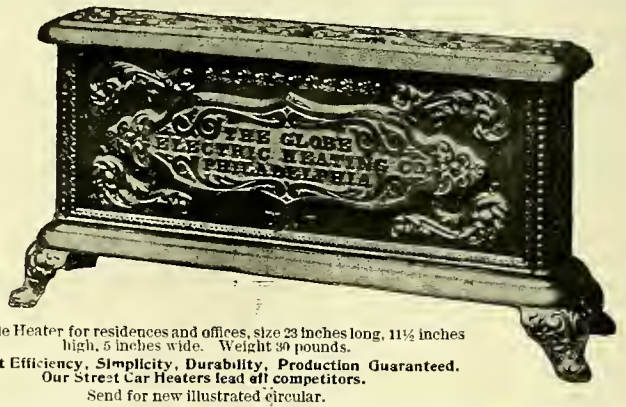

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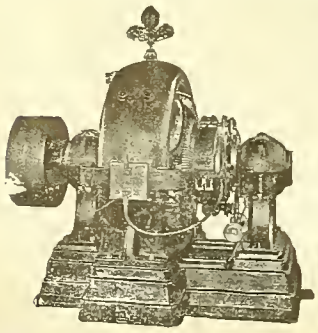

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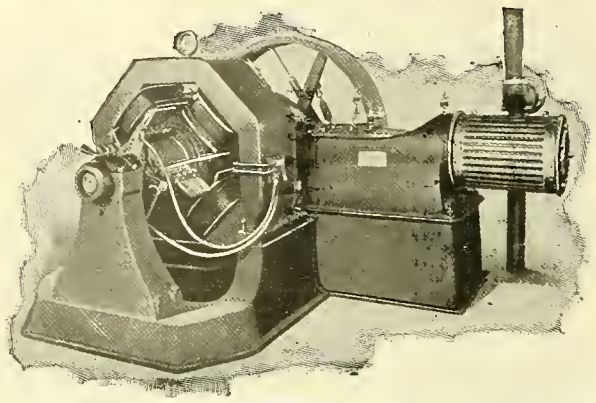

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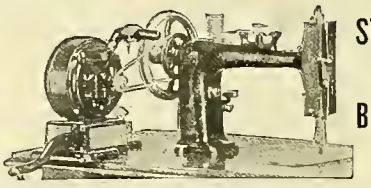

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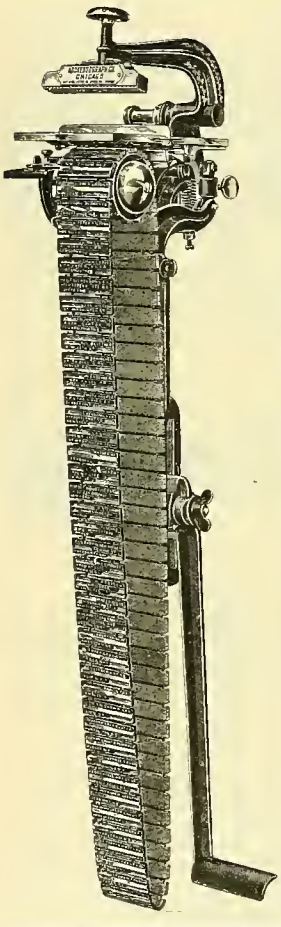

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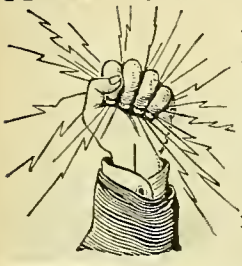

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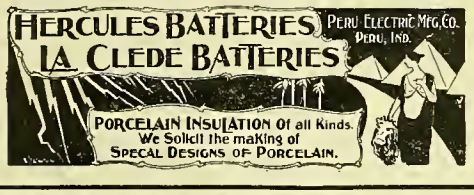

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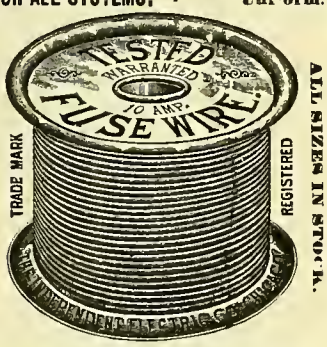

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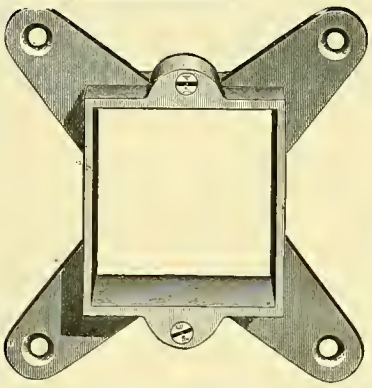

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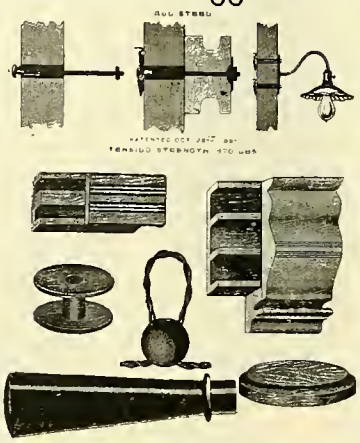

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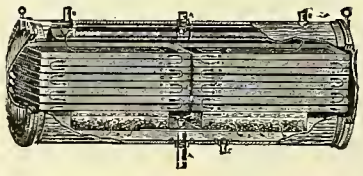

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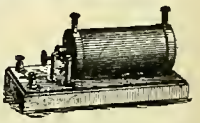

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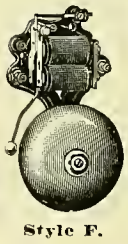

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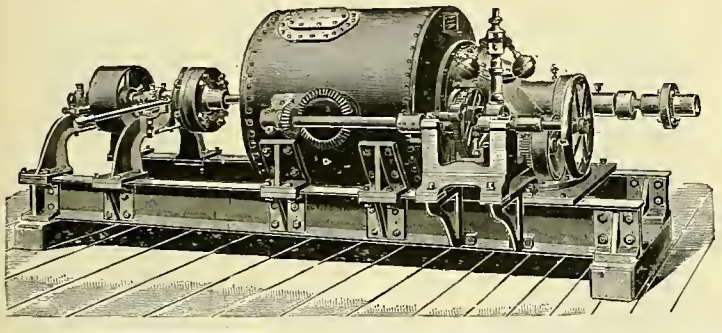

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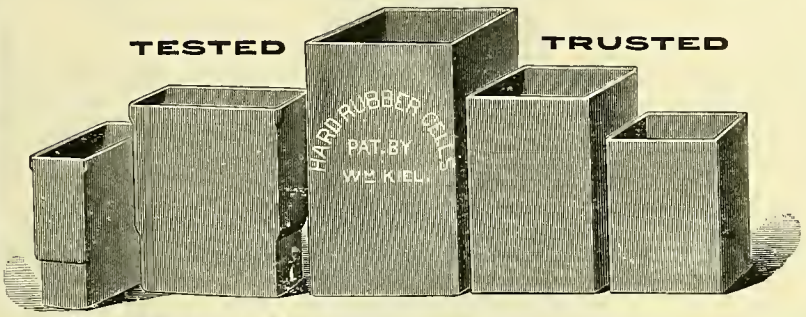

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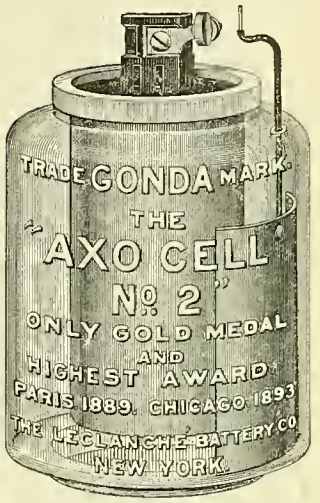

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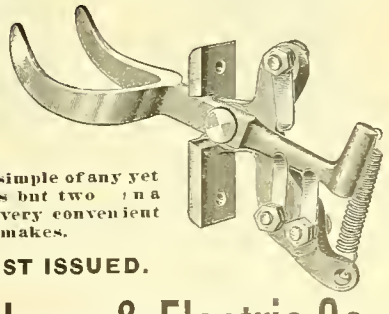

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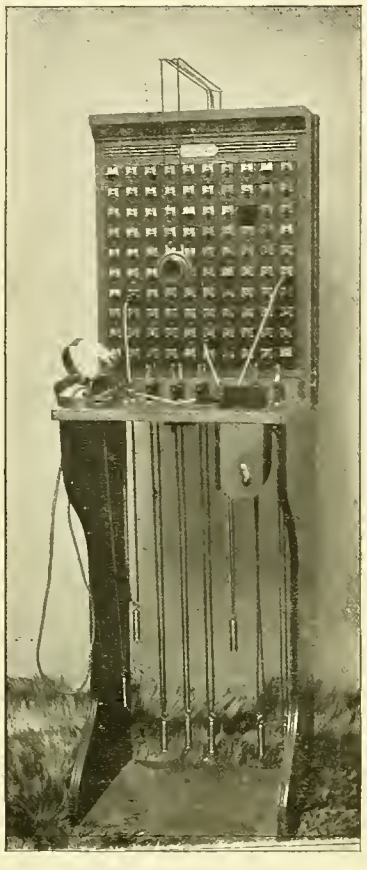

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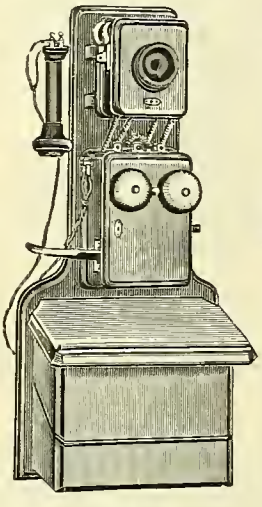

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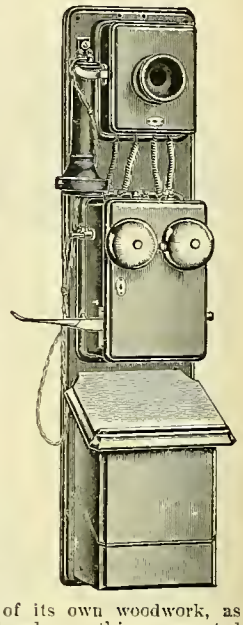

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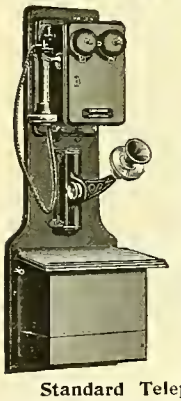

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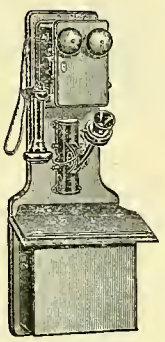

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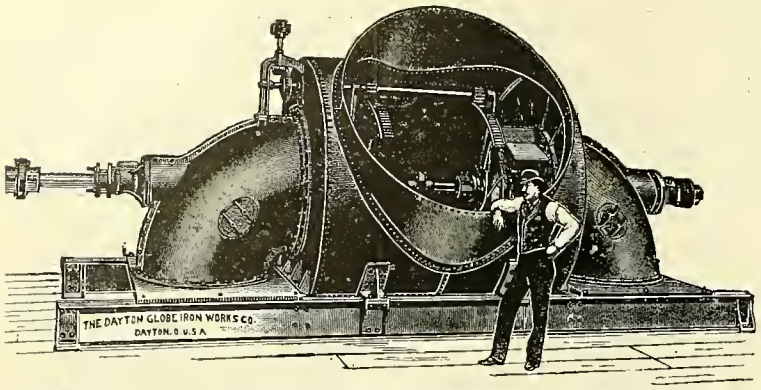

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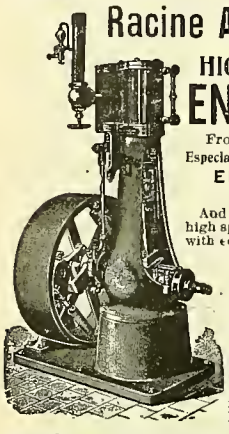

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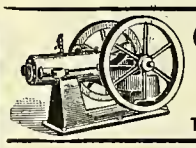

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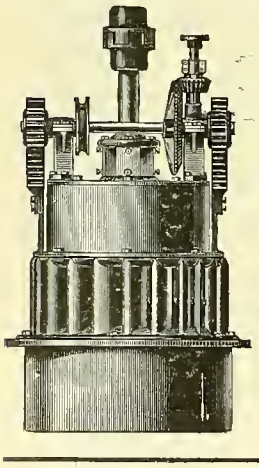

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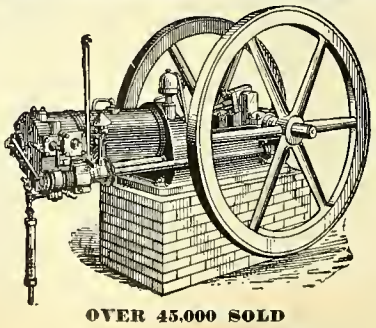

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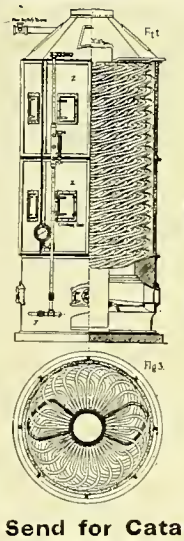

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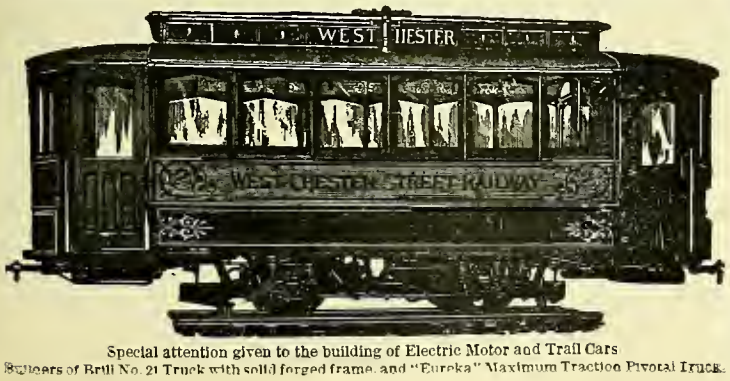

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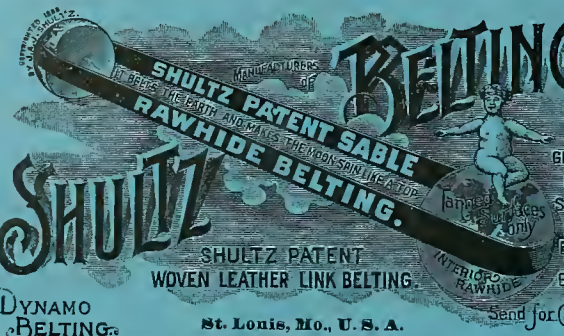

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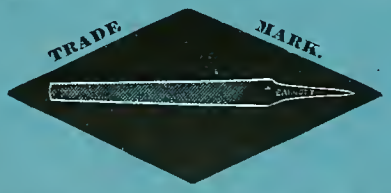

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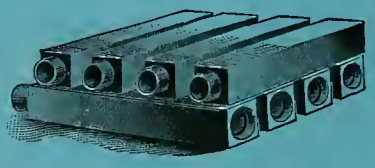

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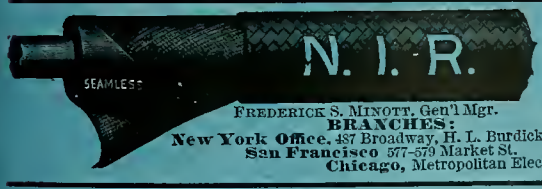

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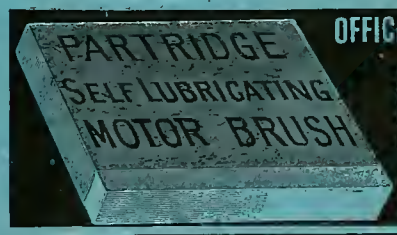

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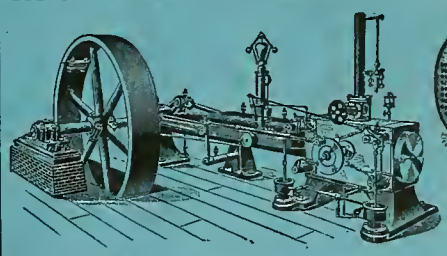

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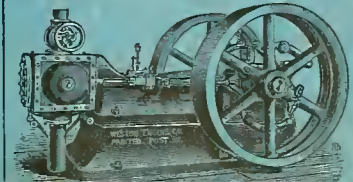

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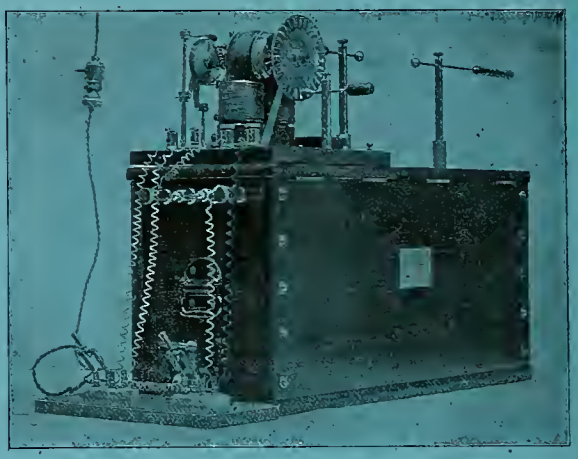

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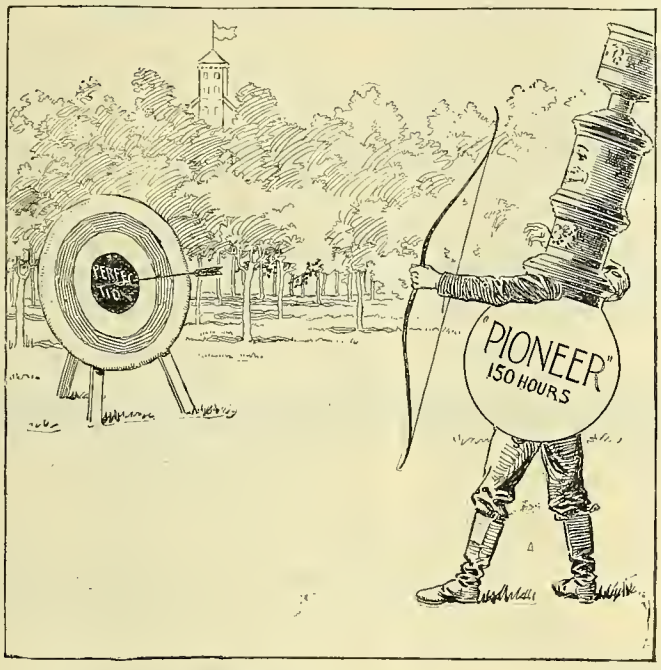

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SOME PEOPLE KNOW A GOOD THING.

CHICAGO, Nov. 2, 1896.
J. B. McKeague, Agt.
Dear Sir:—Please deliver to us ten more Wirt Brushes same as last, and oblige,
MASONIC TEMPLE.
Robert Knickerbocker, Chief Eng.

CHICAGO, Nov. 2, 1896.
J. B. McKeague, 369 Wabash Ave., City.
Dear Sir:—Please deliver to us twenty more Wirt Brushes, ⅛x⅝x8, and oblige,
AUDITORIUM HOTEL.
Geo. M. Cowan, Chief Eng.

J. B. McKeague, Western Agent, 369 Wabash Ave., Chicago. Write for Circular. **Charles Wirt. Patentee and Sole Maker, Factory, Philadelphia.**

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

"ARMORITE"!

INTERIOR CONDUIT

(CUMMING'S PATENTS.)

Note how the Wood-Lining does not crack.

ARMORITE INTERIOR CONDUIT CO., OFFICE AND WORKS, 478-480 FORT STREET, WEST. DETROIT, MICH.

ELECTRIC APPLIANCE CO., Chicago, General Western Agents.

ANDRAE

Has been known to the electrical trade since many years. The business was established 1860 in the city of

MILWAUKEE.

We furnish complete electric light plants for factories, mills, office buildings, steamboats. Experienced men sent to all parts of the country to do construction work, etc. He also

SELLS

All first-class articles used in electric light and power stations. A complete line of

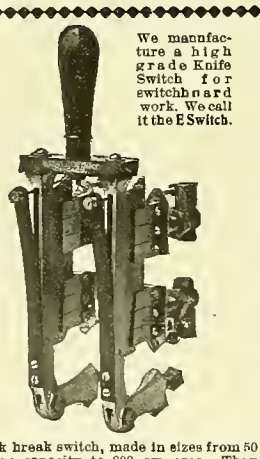
ELECTRICAL

House goods, bells, batteries, push buttons, etc. A large stock of

SUPPLIES

Carried constantly on hand and all orders filled promptly. Our telephones can't be beat. Give us a trial.

Julius Andrae & Sons Co., - Milwaukee, Wis.



We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.

A quick break switch, made in sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

We have in stock in our Chicago Store

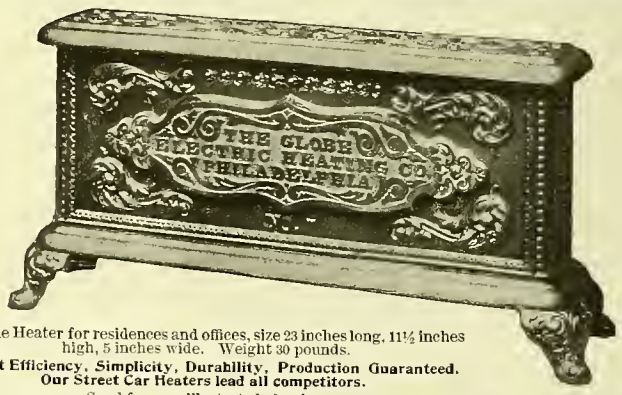
WAITING FOR YOUR ORDERS

Sockets, Switches, Cut-Outs,
Tubes and Insulators,
Shawmut Fuse Wire and Knife Switches,
Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

Western Electric Company.

Chicago. New York.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

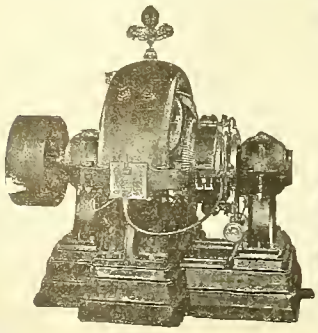
Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.

READ THE BLUE ELECTRICAL PAPER.

THE CARD ELECTRIC COMPANY,

Mansfield, Ohio.



CARD Generators for Power Transmission and Isolated Lighting. Generators are all Multipolar and Slow Speed.

CARD Multipolar Slow Speed Stationary Motors. Reversible Motors and Controllers for Rolling Mills, Bridges, Traveling Cranes and Elevators,

Agents Wanted in Unoccupied Territory. **Write for Estimates.**

We are General Agents for

WAGNER TRANSFORMERS,

OKONITE IT NEVER DISAPPOINTS

And carry a full assortment of sizes in Chicago stock ready for prompt delivery. Correspondence solicited.

Central Electric Company,

ELECTRICAL SUPPLIES,

173-175 Adams St., CHICAGO.

ST. LOUIS:
Southern Electrical Supply Co.

KANSAS CITY:
Gate City Electric Co.

NEW ORLEANS:
404 Carondelet St.

BUFFALO:
742 Guaranty Building.

PURITAN

Alternating Arc Lamp.

IT IS SHORT AND ORNAMENTAL. . .

IMMEDIATE SHIPMENTS CAN BE MADE.

BURNS 100 HOURS.

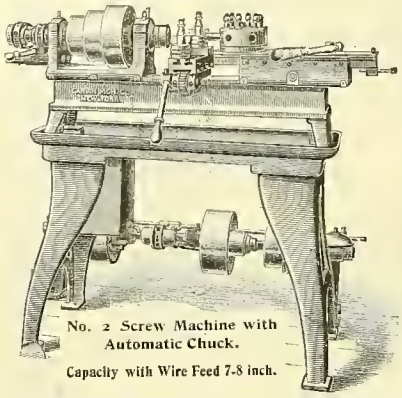
WRITE FOR PARTICULARS AND DESCRIPTIVE PAMPHLET.

NOISELESS.

Puritan Electric Co., 152 Nassau St., New York, N. Y.
35 Federal St., Boston, Mass.

The GARVIN MACHINE CO.,

51 N. 7th Street, PHILADELPHIA. SPRING AND VARICK STREETS, NEW YORK.



No. 2 Screw Machine with Automatic Chuck.

Capacity with Wire Feed 7-8 inch.

We build 6 sizes of

Screw Machines

RANGING IN CAPACITY

From 1-4 inch to 2 1-8 inches.

WITH OR WITHOUT

Wire Feed, Back Gears, Geared Friction Head, Automatic Feed and Chasing Bar,

As the Size and Style of Work Require.

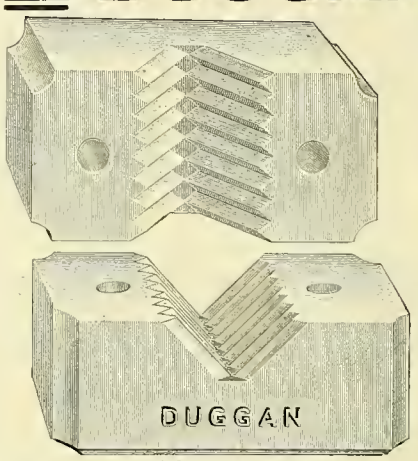
WRITE FOR CATALOGUE AND PRICES.

MACHINERY and MACHINE TOOLS

OF ALL KINDS KEPT IN STOCK.

THE DUGGAN CLEAT

LEADS THEM ALL.



Patented November 14, 1893.

When ordering see that you get the DUGGAN.

Made in one wire No. 4, 5 and 6.
Two wire No. 2 and 3.
Three wire No. 1.

They are corrugated and V-shaped groove.

They grip like a vise.

No sagging wire when once stretched.

They are made of the finest glazed porcelain. Ten of them used to one of any other make.

No. 1, 3 and 4 holds wire 16 to 8.
No. 2 and 5 holds wire 6 to 00.
No. 6 hold wire 000 and larger.

Imperial Porcelain Works,

369 Wabash Ave., Chicago, Ill.
Factory, Trenton, N. J.
Porcelain Specialties of all kinds.

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Partrick & Carter Co.

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Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points & Plates.
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Chicago Edison Co.
Chicago General Fixture Co.
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Electric Appliance Co.
General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
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Wertheim, Ed.
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Card Electric Co.
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Eddy Elec. Mfg. Co.
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Westinghouse Elec & Mfg Co.
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Western Electric Co.

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Phila. El. & Mfg. Co.
Westinghouse El. & Mfg. Co.

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Pacific Electric Co.

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Brush Electric Co.
Card Electric Co.
Central Electric Co.
Clymer & Heilman.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Glosburg, R. L. & Sons.
Hine & Co., L. A.
Jenney Elec. Motor Co.
Northern Electl. Mfg. Co.
Ruprecht Electric Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Westinghouse El. & Mfg. Co.

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Fuel Economizer Co.

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American El. Heating Corp.
Detroit Elec. Heating Co.
Globe Elec. Heating Co.
Johns, H. W., Mfg. Co.

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American El. Meter Co.

Electric Railways.
Brush Electric Co.
Card Electric Co.
General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
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Bain, Foree.
Bryan & Humphrey.
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Patitz, A. M.
Pratt. Chas. A.

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Clymer & Heilman.
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Cutter El. & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Gilmore El. & Mfg Co.
Keystone El. Instrument Co.
McKeague, J. B.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

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American Elec. Fuse Co.
American El. Heating Corp.
Andrae, J. & Sons Co.
Automatic Cir. Breaker Co.
Central Electric Co.
Clymer & Heilman.
Commercial El. Supply Co.
Electrical Mfg. & Sup. Co.
Imperial Porcelain Works.
Lever, C. H. Mfg. Co.
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Pacific Electric Co.
Partrick & Carter Co.
Pearson, F. J. Mfg. Co.
Phila. El & Mfg. Co.
White Co., The O. C.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Colburn El. Mfg. Co.
General Electric Co.
Jenney Elec. Motor Co.

Engines, Gas
Otto Gas Engine Wks.
Van Duzen Gas & Gso. Co.Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Murray Iron Works.
Philadelphia Eng. Works.
Racine Hardware Co.
Weston Engine Co.

Engravers.
Illinois Engraving Co.

Fan Outfits.
Central Electric Co.
Commercial El. Supply Co.
Interior Conduit & Ins. Co.
Westinghouse El. & Mfg. Co.

Fibre.
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fire Alarms.
Western Electric Co.

Fixtures, El. & Comb'n.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.

Fuse Wire.
Brixey, W. R.
Chicago Fuse Wire & Mfg.Co.
Commercial El. Supply Co.
Electric Appliance Co.
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Gaskets.
Jonns, H. W., Mfg. Co.
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Besly & Co., Chas. H.

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Andrae, J. & Sons Co.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Clymer & Heilman.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Farr Tel. & Const. Supply Co.
Forest City Elec. Wks.
General Electric Co.
Gilmore El. & Mfg. Co.
Hodge, Walsh & Loring.
Huebel & Manger.
Interior Conduit & Ins. Co.
International Elec. Co.
Johns, H. W., Mfg. Co.
Metropolitan Electric Co
Midland Electric Co.
Morrison Southern El. Co.
Northwest Engineering Co.
Ohio Electric Works.
Pacific Electric Co.
Partrick & Carter Co.
Pearson, F. J. Mfg. Co.
Peru Elec. Mfg. Co.
Phila. El. & Mfg. Co.
Sioux City Brass Works.
Westinghouse El. & Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Hemingray Glass Co.
Locke, Fred. M.
Murray & Co., Jas. J.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv.Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
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Hard Rubber Goods.
Butler Bard Rubber Co.
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Induction Coils.
International Elec. Co.
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Insulators and Insulating Materials.
Andrae, J. & Sons Co.
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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Empire China Works.
Farr Tel. & Const. Supply Co.
Fiberite Co., The.
Gilmore El. & Mfg. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
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Ind. Rubber & Ins. Wire Co.
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Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

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Farr Tel. & Conet. Supply Co.
General Electric Co.
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National India Rubber Co.
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Okonite Co., The.
Phillips Insulated Wire Co.
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Lamps, Incandescent.
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Metropolitan Electric Co.
Ohio Electric Works.
Pacific Electric Co.
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Garvin Machine Co., The.
Hine & Robertson.
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Tagatz, H. A.

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Commercial El. Supply Co.
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General Electric Co.
Imperial Porcelain Works.
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McKeague, J. B.
Peru Elec. Mfg. Co.

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Electrician Publishing Co.

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Rockwood Mfg. Co., The.

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Whitney Elec. Inst. Co.

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Electric Storage Battery Co.
Willard Elec. & Battery Co.

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Brill Co., J. G.

Supporters, Inc. Lamp.
White Co., The O. C.

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Central Electric Co.
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Electric Appliance Co.
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Simple, Durable, Economical.

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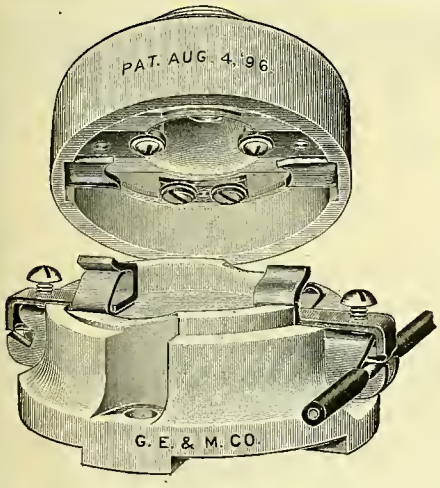

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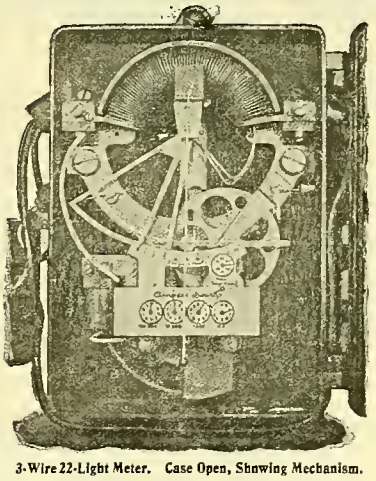

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SAN FRANCISCO, Mills Building.
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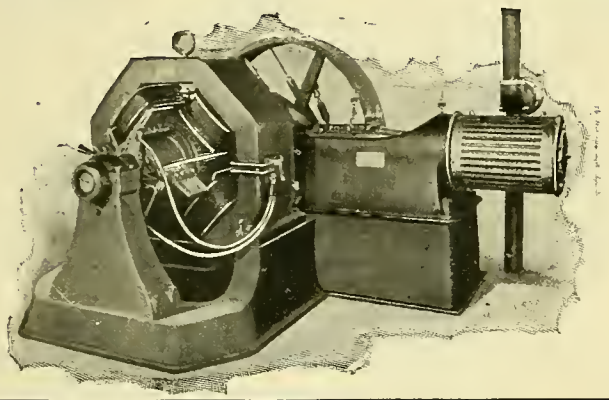

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We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

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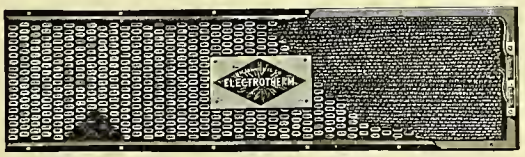

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No coils to short-circuit or break, no oxidation, perfect air circulation, easily controlled and regulated by patented knife switch. Adjustable to three different degrees of heat. Prices, etc., on application.

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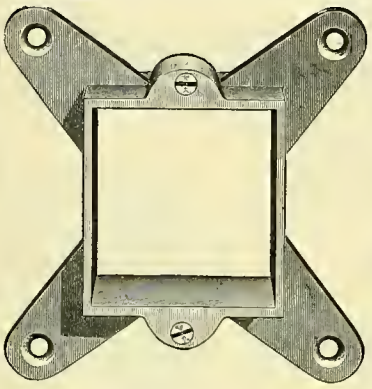

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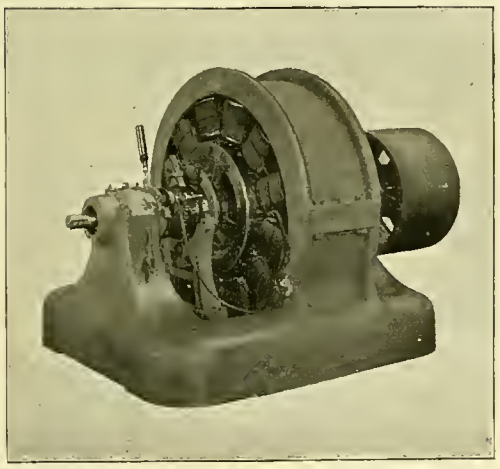

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INCANDESCENT LAMPS, ARC LAMPS AND MOTORS,

FROM THE SAME CIRCUITS.

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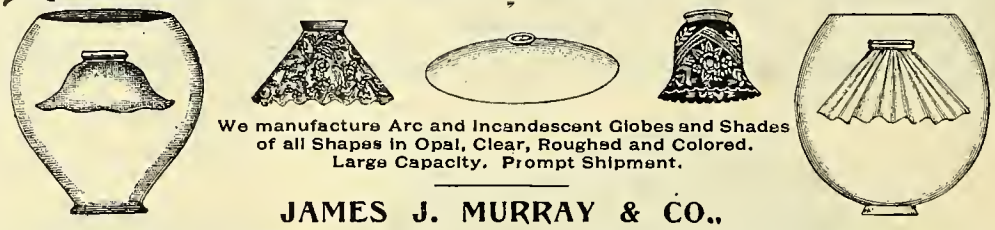

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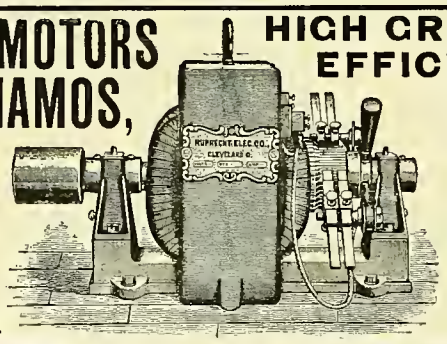
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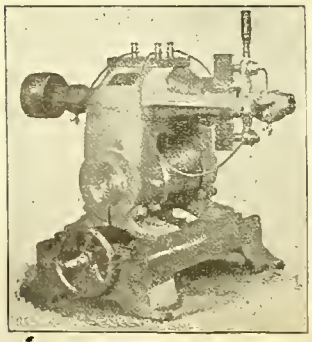
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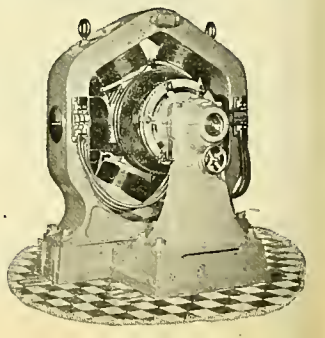

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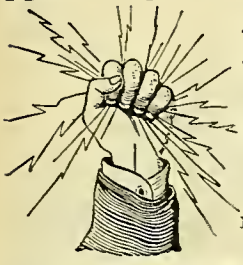

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FOR SWITCHBOARD, RAILWAY and MOTOR USE.

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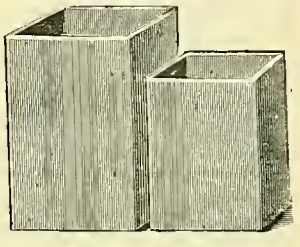

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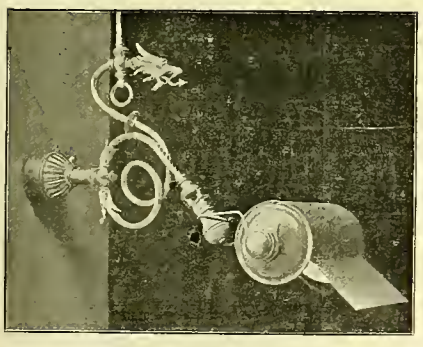

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Constant potential, 150 K. W., Type A 23-1 Volts, 500; amperes, 300. Detroit Electrical Works' Standard. Apply to

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One 1,000 light incandescent dynamo and one 100 light incandescent. Both direct current, compound wound.

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Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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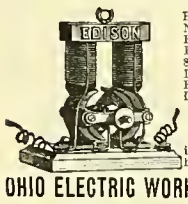

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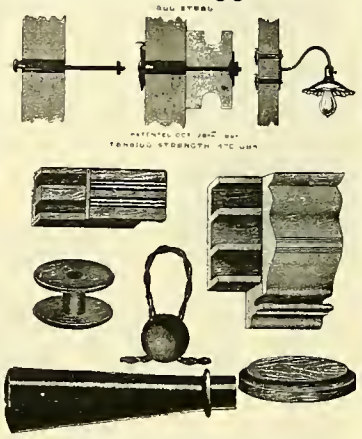

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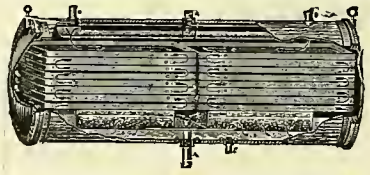

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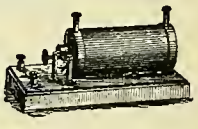

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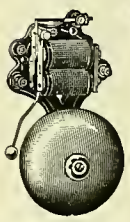

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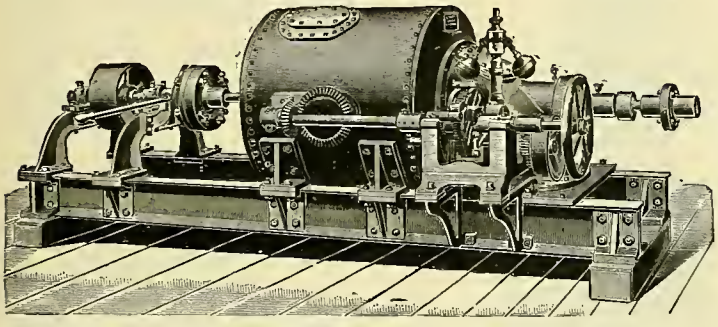

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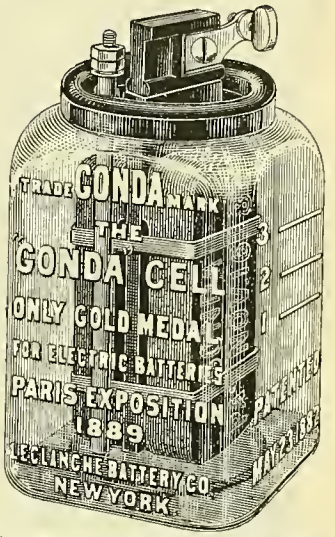

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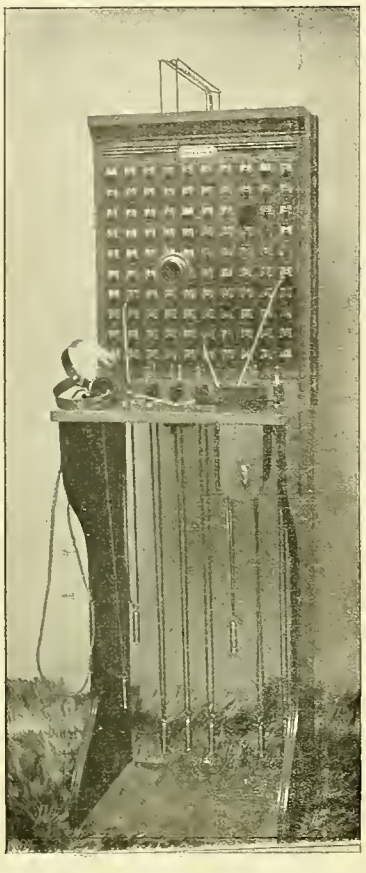

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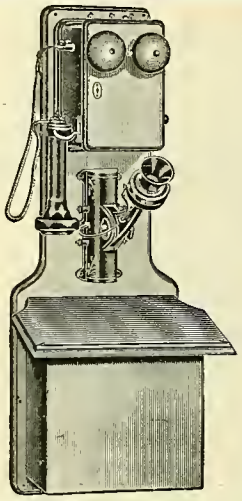

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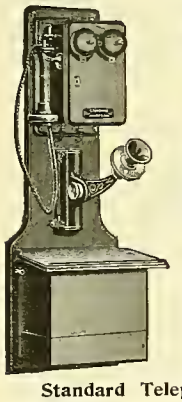

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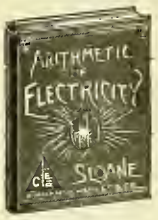

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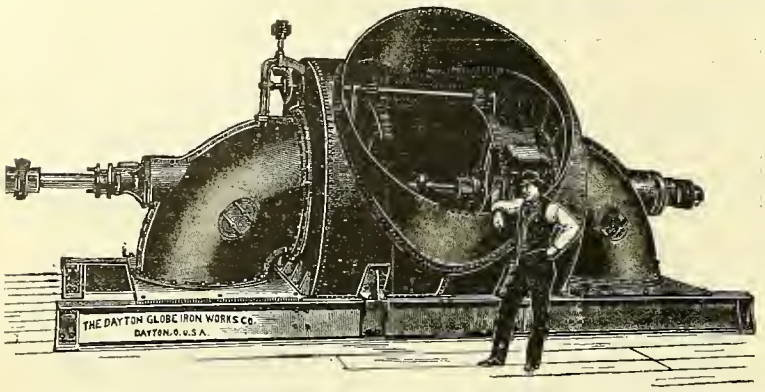

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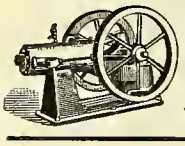

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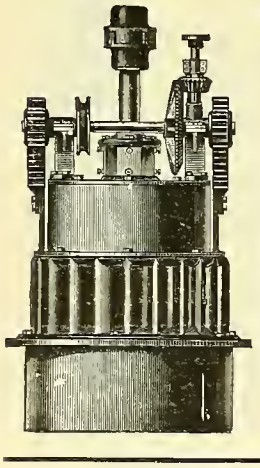

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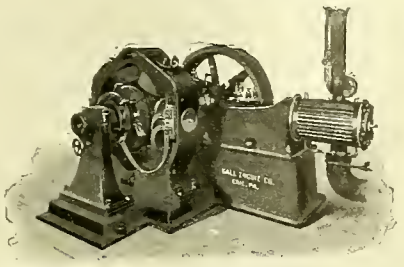

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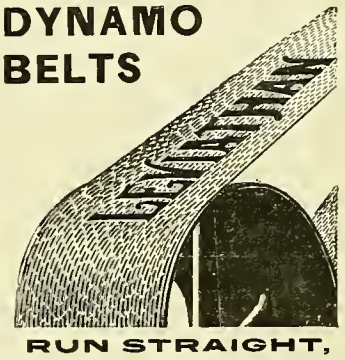

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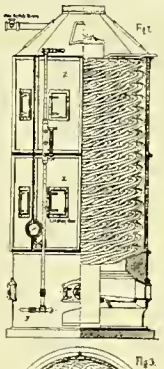

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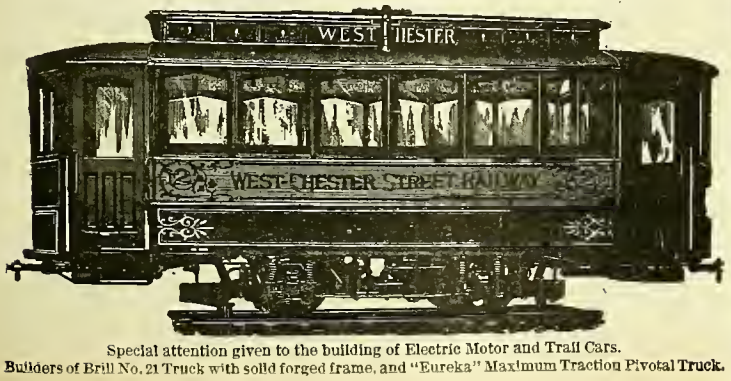

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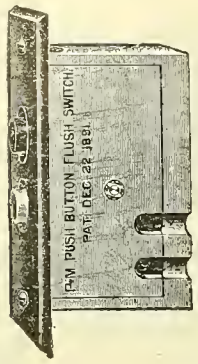

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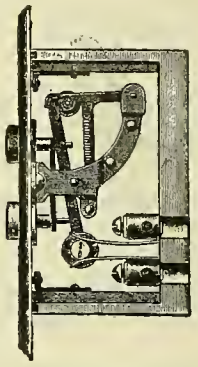

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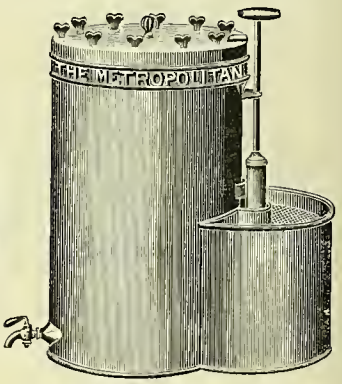

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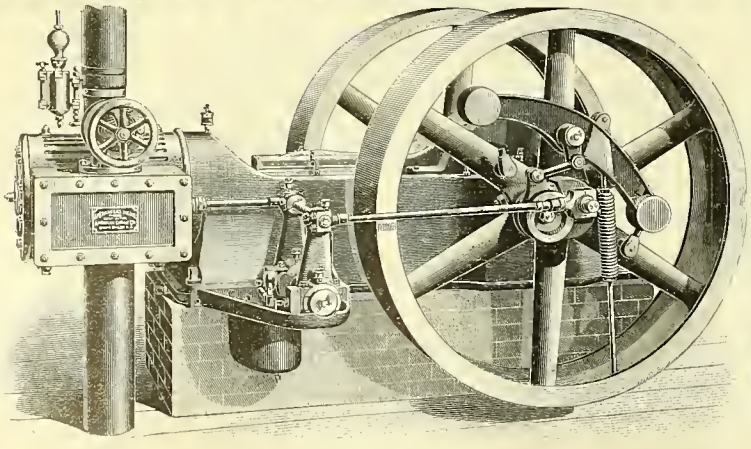

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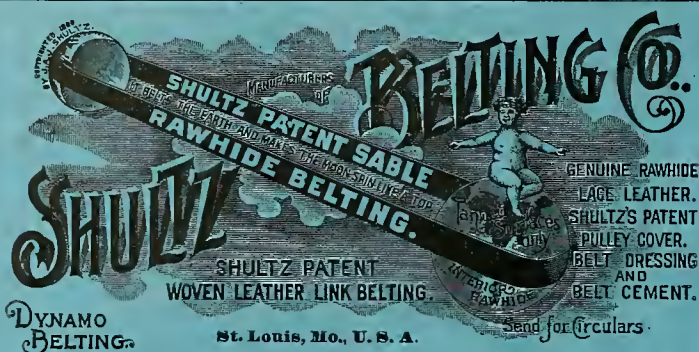

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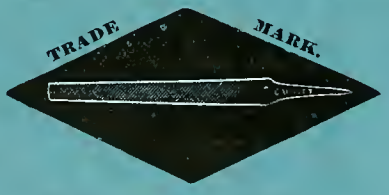

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White Core Lamp Cord.

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INSULATED WIRES and CABLES

For Aerial, Submarine and Underground Use.

Telephone and Telegraph Cables a Specialty.

Indiana Rubber & Insulated Wire Co., JONESBORO, INDIANA.

HAVE **YOU** SEEN

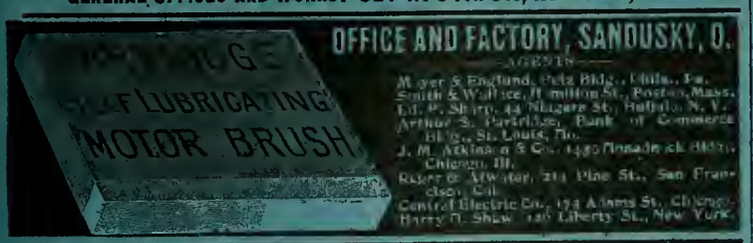
A SAMPLE OF OUR NEW

Standard Iron Armored Insulating Conduit?

SAMPLES UPON APPLICATION.

INTERIOR CONDUIT & INSULATION CO.,

GENERAL OFFICES AND WORKS: 527 W. 34TH ST., NEW YORK, N. Y.



WESTON Electrical Instrument Co.,

114-120 William St., NEWARK, N. J., U. S. A.

Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed, dust-proof cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.

Weston Standard Illuminated Dial Station Voltmeter, Style B.

Weston Standard

Portable Direct Reading Voltmeters and Millivoltmeters, Ammeters and Milliammeters, Wattmeters and Voltmeters, for Alternating and Direct Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

The NORTHERN ELECTRICAL MFG. CO.,

Madison, WIS.,

Manufacturers of **MOTORS AND DYNAMOS.**

Our machines will operate SUSPENDED from CEILING OVERHEAD or BOLTED DIRECT to SIDE WALL as readily as when occupying floor space in the ordinary manner. All bearings self-oiling. See our new patented device for CONNECTING MOTORS DIRECT TO LINE SHAFT SAVING BELTS, PULLEYS AND FLOOR SPACE. . . . . .

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THE ROOKERY, CHICAGO. WESTINGHOUSE BUILDING, PITTSBURG. TIMES BUILDING, NEW YORK.

ELECTRIC CABLES, CONDUITS, WIRES AND ACCESSORIES.

Also high-grade rubber covered Wires & Cables.

HIGHEST AWARDS

PARIS 1867. CHICAGO 1893. PHILADELPHIA 1876.

DAYS KERITE

INSULATED WIRES AND CABLES.

AERIAL, UNDERGROUND, SUBMARINE.

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S. F. B. MORSE, Western Agent.

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IRON CLAD RHEOSTAT CO., Westfield, N. J.

Queen & Co.,

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Acme Testing Sets, Queen-Wirt Switchboard Instruments, X-Ray Focus Tubes, Induction Coils.

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For all Purposes.

Scrap and Native Platinum Purchased.

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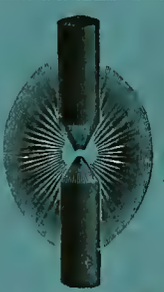

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FOR ARC LIGHTS.

Soft Cored and Solid.

WRITE FOR PRICES.

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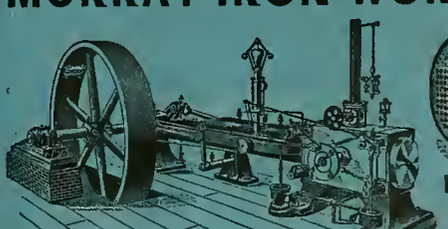
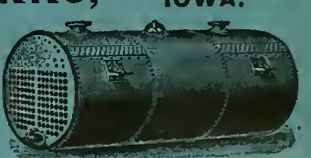
ED. WERTHEIM, ..Chicago.

MURRAY IRON WORKS, BURLINGTON, IOWA.





Economical Power Plants Complete.

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GREEN'S ECONOMIZER

For Steam Boilers.

SAVES 10% TO 20% IN FUEL.

SOLE MAKERS IN THE U. S. A.

THE Fuel Economizer Co.,

MAIN OFFICE AND WORKS: MATTEAWAN, N. Y.

WESTON ENGINES.

High Pressure Boilers.
Complete Power Plants.

Estimates and Drawings Submitted.

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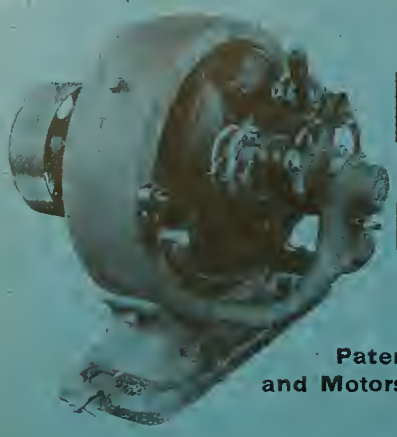
SCRANTON SUPPLY & MACH'Y CO., - Scranton, Pa.
THOS. K. CAREY & BROS. CO., 26 Light St., Baltimore, Md.
MITCHELL, LEWIS & STAVER CO., [illegible]
THOS. K. CAREY & BROS. CO., 26 Light St., Baltimore, Md.



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15 to 1,000 Lights.

MOTORS,

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ANY VOLTAGE.

Patented adjustable Dynamos and Motors for floor, wall or ceiling.

The Ahlm-Edwards Electric Co., MEDINA, OHIO.

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—AND—

Electric Motors

Storage Batteries.

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X-RAY COIL

Can be Relied Upon to Work at All Times.

Undisputed Supremacy.

WHAT OTHERS SAY MAY INTEREST YOU.

Messrs. L. E. KNOTT APPARATUS CO. Urbana, Ohio., August 8, 1896.

Gentlemen:—Your high frequency coil for alternating circuit is giving very satisfactory results in the Roentgen experiments. Our Medical Association has expressed its highest appreciation of the working and results of the Coil. I am safe in saying that my experiments have verified your high claims of its efficiency.

Very truly, I. N. KEYSER, Prin. Urbana High School.

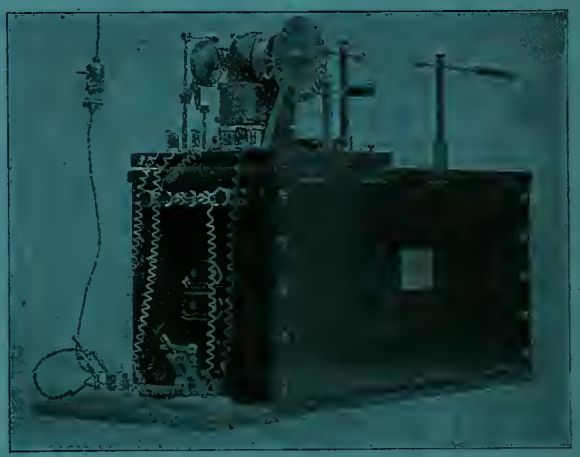
Manufacturers of High-Grade X-Ray Apparatus, mechanically and scientifically perfect.

L. E. Knott Apparatus Co.,

Microscopic, Chemical and Physical Apparatus,

14 ASHBURTON PLACE, BOSTON, MASS.

New X-Ray Paper, Superior to Plates.



Knott Direct Current High Frequency Coil for X-Ray Work.

THE K. A. K. CONDUIT SYSTEM.

Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.

Practical in Operation.

SEND FOR FULL PARTICULARS.

KROTZ, ALLEN & KELLY, SPRINGFIELD, OHIO.

MEDBERY SWITCHES Best Switch for the Least Money.

Single, Double and Triple Pole. Single and Double Throw, with or without Fuse Extension.
Handsomely Finished. Absolutely Reliable.

. . . MEDBERY INSULATION AND OVERHEAD TROLLEY EQUIPMENT. . .

THE STANDARD RAILWAY MATERIAL OF THE WORLD.

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S. F. B. MORSE, Marquette Building, Chicago. FLEMING & POILLON, 39 Cortlandt Street, New York.

Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.

WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.

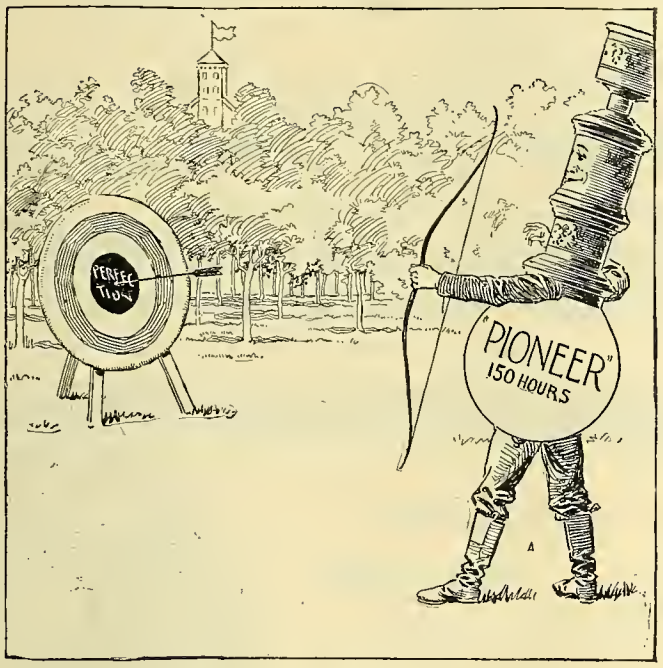
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.

COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

SAMPLE UPON APPLICATION.

C. P. WILLIAMS, Sole Agent U. S. A. 39-41 Cortlandt St., New York City.



The "Pioneer" Has Hit Perfection.

The best light.

Softest, steadiest and whitest.

The mechanism simplest.

The operation safest and most economical.

THE ELECTRIC ARC LIGHT CO.

LOUIS B. MARKS, M.M.E.
CHIEF ELECTRICIAN.

687 & 689 Broadway,
NEW YORK.

PIONEERS IN ENCLOSED ARC LIGHTING
THE PIONEER
TRADE MARK
150 HOURS.

Incandescent Lamps. FOR 30 DAYS, 10% DISCOUNT.

Why encourage trusts, when you can procure from us lamps made from the highest grade stock, **Cellulose Filament, Hydro-Carbon Joints, with Perfect Vacuum,** for 10 per cent. less? Our mode of pumping, together with specially prepared sealed joints, enables us to guarantee lamps not to blacken, and to show the best maintenance of candle power and life.

High, Medium or Low Efficiency. We guarantee efficiency to be as ordered, and for one month will send with each barrel order our **Current Testing Apparatus** free of charge, which will accurately show the consumption of current on any make incandescent lamp (we are glad to show the economy of ours), and solicit a trial order.

Double Coiled unanchored filaments, for car and factory work (3 to 4 watts per C. P).

Cash Rebate of 2 cents each for burned out lamps of our manufacture.

Lamp Testing Apparatus, with which 300 lamps can be measured in one hour on direct or alternating current, any voltage, for $1.50, cash with order.

JAMES C. WORMLEY & CO., Marquette Building, CHICAGO, ILL.

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

ANDRAE

Has been known to the electrical trade since many years. The business was established 1860 in the city of

MILWAUKEE.

We furnish complete electric light plants for factories, mills, office buildings, steamboats. Experienced men sent to all parts of the country to do construction work, etc. He also

SELLS

All first-class articles used in electric light and power stations. A complete line of

ELECTRICAL

House goods, bells, batteries, push buttons, etc. A large stock of

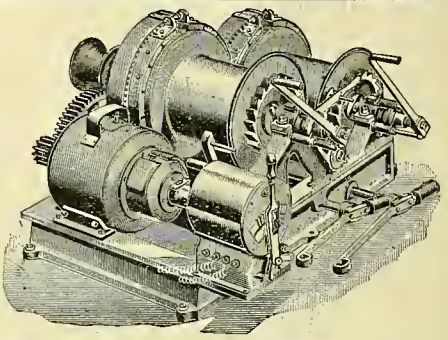
SUPPLIES

Carried constantly on hand and all orders filled promptly. Our telephones can't be beat. Give us a trial.

Julius Andrae & Sons Co., - Milwaukee, Wis.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

CHICAGO OFFICE: Metropolitan Elec. Co., 186-188 Fifth Ave.
NEW YORK OFFICE: 130 Liberty Street.
BRANCH FACTORY: Hamilton, Canada

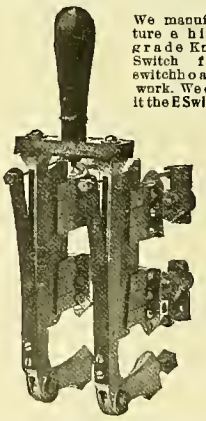
A. M. PATITZ,

Mechanical and Electrical Engineer, M. A. S. M. E.,

SUITE Nos. 1101 and 1102 Pabst Building,

MILWAUKEE, WIS.

Electric Light and Power Plants; Electric Railways; Engine and Boiler Plants; Water Turbines; Pumping Plants; Heating and Ventilating Plants; Electric Transmissions a specialty. Special Tools designed. Consultations, Examinations, Reports, Plans, Specifications, Estimates, Superintendence and Purchasing.



We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.

A quick break switch, made in sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

We have in stock in our Chicago Store

WAITING FOR YOUR ORDERS

Sockets, Switches, Cut-Outs,
Tubes and Insulators,
Shawmut Fuse Wire and Knife Switches,
Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

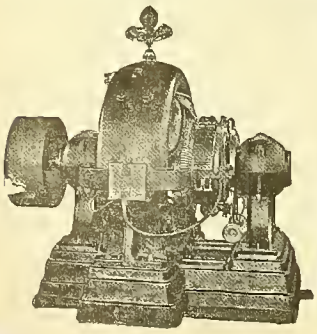
Western Electric Company.

Chicago. New York.

READ THE BLUE ELECTRICAL PAPER.

THE CARD ELECTRIC COMPANY,

Mansfield, Ohio.



CARD

Generators for Power Transmission and Isolated Lighting.
Generators are all Multipolar and Slow Speed.

CARD

Multipolar Slow Speed Stationary Motors.
Reversible Motors and Controllers for Rolling Mills, Bridges, Traveling Cranes and Elevators,

Agents Wanted in Unoccupied Territory. **Write for Estimates.**

We are General Agents for

WAGNER TRANSFORMERS,

OKONITE IT NEVER DISAPPOINTS

And carry a full assortment of sizes in Chicago stock ready for prompt delivery. Correspondence solicited.

Central Electric Company,

ELECTRICAL SUPPLIES,

173-175 Adams St., CHICAGO.

ST. LOUIS:
Southern Electrical Supply Co.

KANSAS CITY:
Gate City Electric Co.

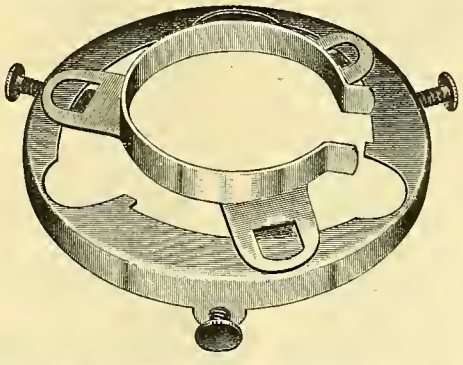
NEW ORLEANS:
404 Carondelet St.

BUFFALO:
742 Guaranty Building.

What, a Perfect Shade Holder?

YES! THE ONLY ONE THAT FITS ALL SOCKETS,
Keeping Lamp in Center of Shade Ring.

IT IS NEW AND ALL WE CLAIM FOR IT.



PURCHASE THIS, SAVE TROUBLE AND PLEASE CUSTOMERS.

No Clamp Screw. Can be Detached by Half-turn of the Hand.

Is fastened on the wedge principle: cannot get loose. Can be attached to Edison socket without removing the rubber or porcelain screw on lower end.

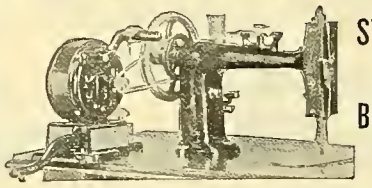
The Housatonic Company,

WALLINGFORD, CONN.

WRITE FOR PRICES.

KENT ALTERNATING

Sewing Machine Motor.

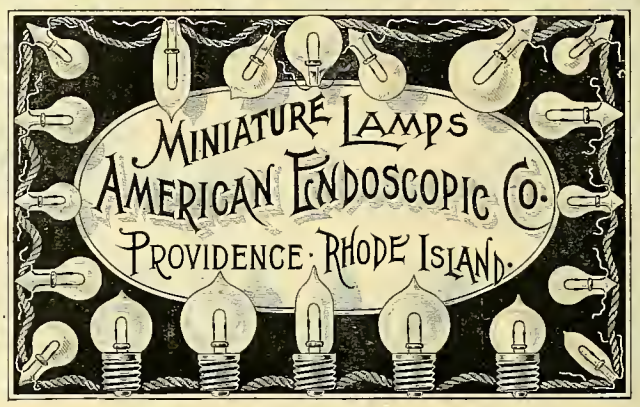


STRANGE, ISN'T IT? BUT WE HAVE IT.

May be applied to any sewing machine where alternating current can be obtained. Speed regulation absolutely perfect. Send for Catalogue H.

Kent Electric Manufacturing Co.,

No. 30 Hermon St., WORCESTER, MASS.



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Electric Storage Battery Co.
Willard Elec. & Battery Co.

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Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
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Diehl Mfg Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
Manhattan Gen'l Cons. Co.
Perkins Elec. Switch Mfg. Co.
Puritan Electric Co.
Van Nuis, C. S.
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Samson Cordage Wks.

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Andrae, J. & Sons Co.
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Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Electric Storage Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Midland Electric Co.
Northwest Engineering Co.
Ohio Electric Works.
Pearson, F. J. Mfg. Co.
Western Electric Co.
Willard Elec. & Battery Co.

Bells.
Central Electric Co.
Commercial El Supply Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.
Western Electric Co.

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Jewell Belting Co.
Main Belting Co.
Shultz Belting Co.

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Clonbrock Steam Boiler Co.
Murray Iron Works.
N. Y. Safety Steam Pr. Co
Racine Hardware Co.
Weston Engine Co.

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Electrician Publishing Co.

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Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

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Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
McKeague, J. B.
Partridge Carbon Co.
Phila. El. & Mfg. Co.
Wirt, Chas.

Burglar Alarms.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.
Western Electric Co.

Cables (See Insulated Wires.)

Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Chicago General Fixture Co.
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Wertheim, Ed.
Western Electric Co.

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Webster Chemical Co.

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Electric Appliance Co.
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McLennan & Co., K.
Okonite Co.
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Camp Co., H. B.
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Williamsp't Wood'n Pipe Co

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Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
Jeaney Elec. Motor Co.
Northern Electl. Mfg. Co.
Patitz, A. M.
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Triumph Electric Co.
Westinghouse Elec & Mfg Co.
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Mansfield Temp. Copper Co.

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American Electrical Works.
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Brixey, W. R.
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Commercial El. Supply Co.
Electric Appliance Co.
Fiberite Co., The.
General Electric Co.
Ind. Rubber & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
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Chicago Edison Co.
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Farr Tel. & Const. Supply Co.
Fiberite Co., The.
Gilmore El. & Mfg. Co.
Hart & Hegeman Mfg. Co.
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Ind. Rubber & Ins. Wire Co.
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Kartavert Mfg. Co.
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McKeague, J. B.
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Okonite Co., The.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
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Eastern Electric Cable Co.
Electric Appliance Co.
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General Electric Co.
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Wormley & Co., Jas. C

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(See Insulated Wires.)

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Garvin Machine Co., The.
Hine & Robertson.
Stilwell-Bierce Smith-Vaile

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Diehl Mfg. Co.
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McLean, A. J.
McNaughton Co., J. C.
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McKeague, J. B.
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Electrician Publishing Co.

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Rockwood Mfg. Co., The.

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Partrick & Carter Co.

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Electric Storage Battery Co.
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Electric Appliance Co.
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Smith, S. Morgan.
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For Alphabetical Index of Advertisements See Page III.

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Constant Potential Circuits.

Simple,
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BURN 100 TO 150 HOURS WITH ONE TRIMMING.

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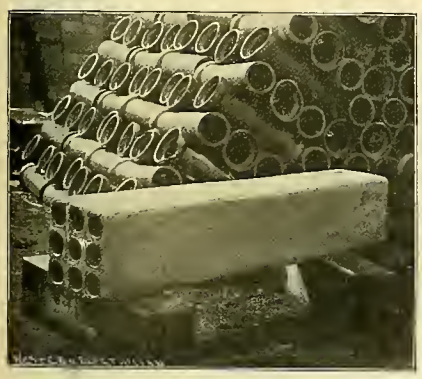

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IS THE ONLY STANDARD.

We Offer the Only Complete System of Electric Wiring.

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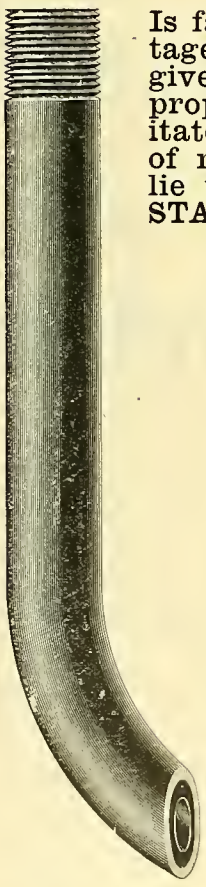
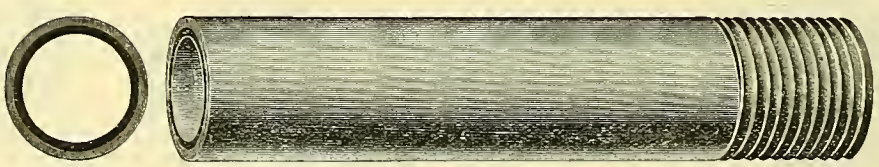
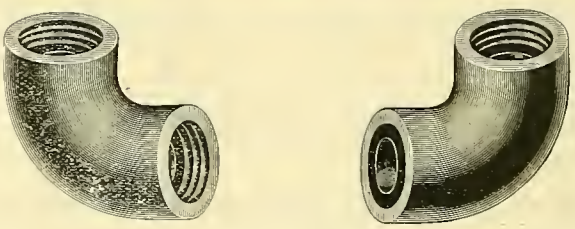
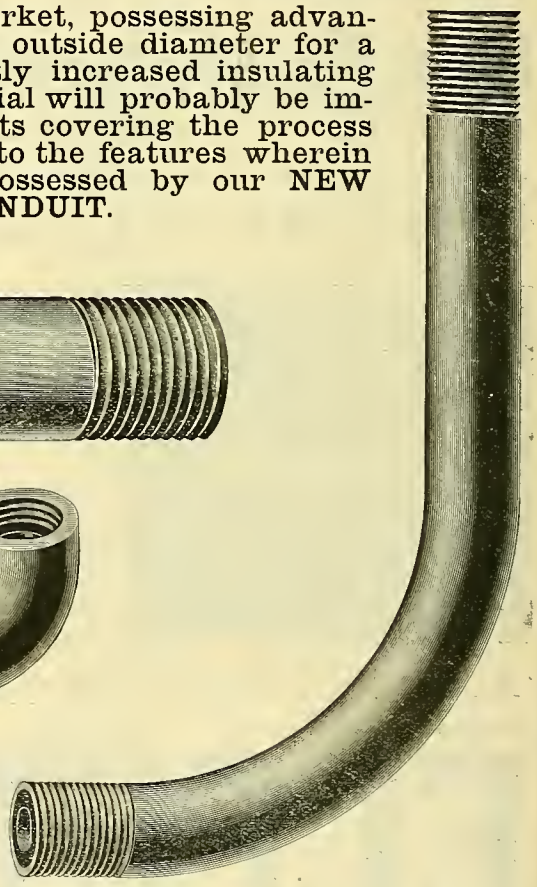


Is far superior to any ever placed upon the market, possessing advantages in that it is extremely light, has a smaller outside diameter for a given inside diameter, and moreover, has greatly increased insulating properties. Like all other standards, this material will probably be imitated. However, the broad, fundamental patents covering the process of manufacture prevent even a near approach to the features wherein lie the strength and integrity of insulation possessed by our NEW STANDARD IRON ARMORED INSULATING CONDUIT.







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HIGH GRADE NUERNBERG CARBONS

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ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.

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Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

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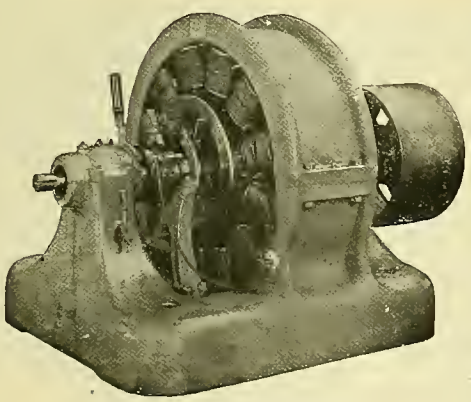

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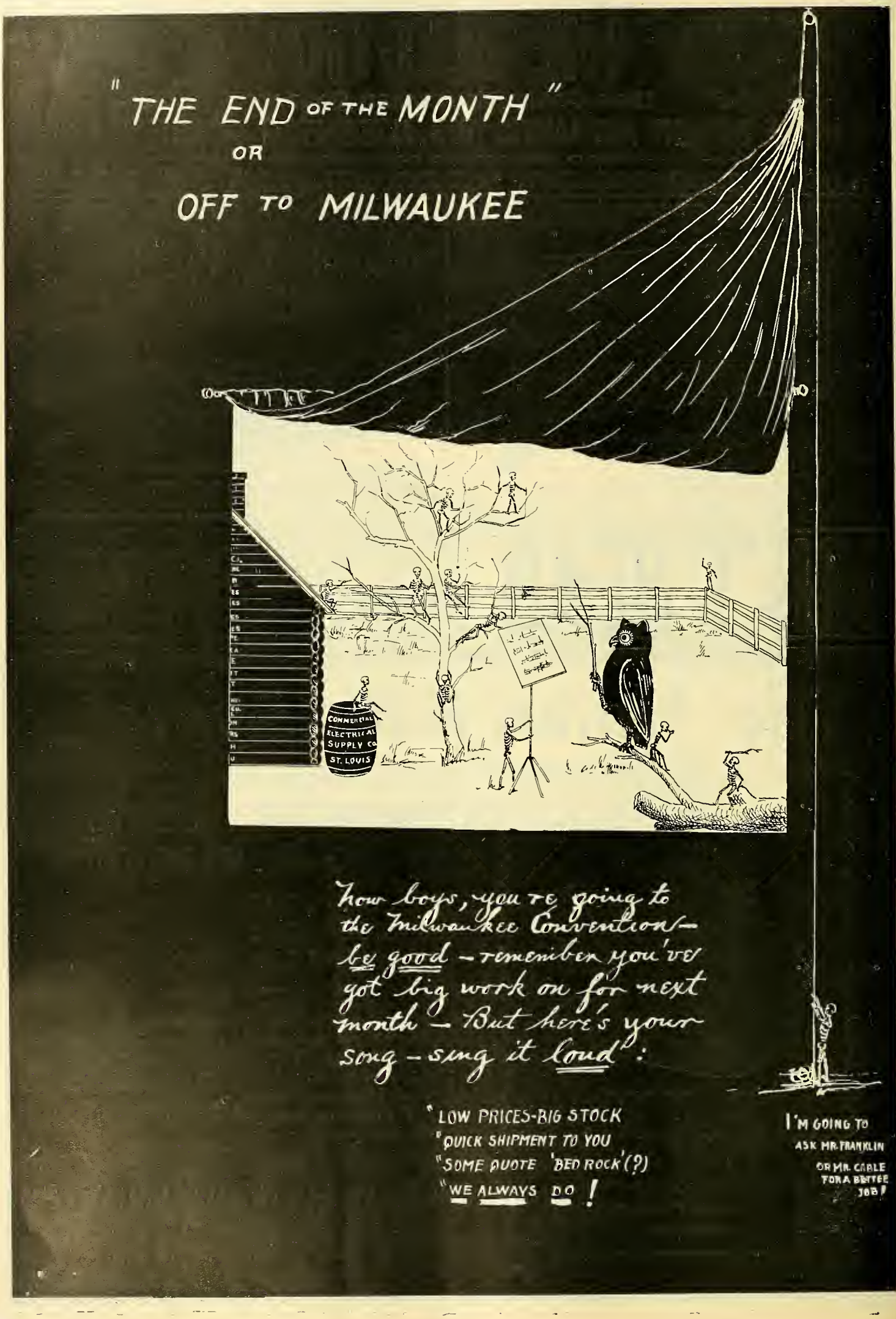
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OR
OFF TO MILWAUKEE
COMMERCIAL ELECTRICAL SUPPLY CO ST. LOUIS
How boys, you're going to the Milwaukee Convention— be good — remember you've got big work on for next month — But here's your song — sing it loud":
"LOW PRICES-BIG STOCK
"QUICK SHIPMENT TO YOU
"SOME QUOTE 'BED ROCK'(?)
"WE ALWAYS DO!
I'M GOING TO ASK MR. FRANKLIN OR MR. CABLE FOR A BETTER JOB!

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Alternating Arc Lamp.

EASY TO TRIM.

Immediate Shipments Can Be Made.

It is Short and Ornamental.

BURNS 100 HOURS.

NOISELESS.

WRITE FOR PARTICULARS.

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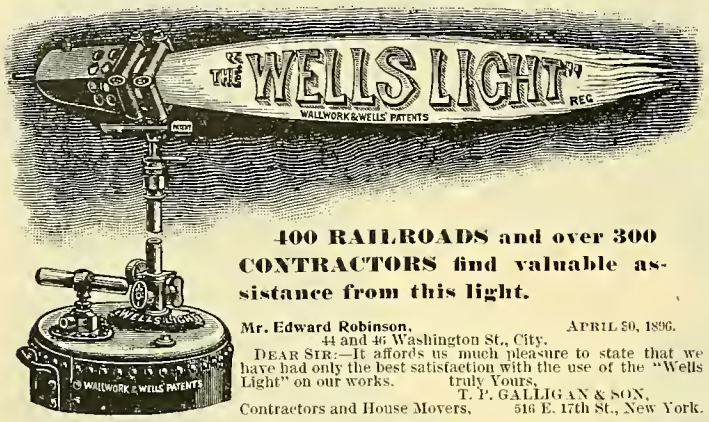

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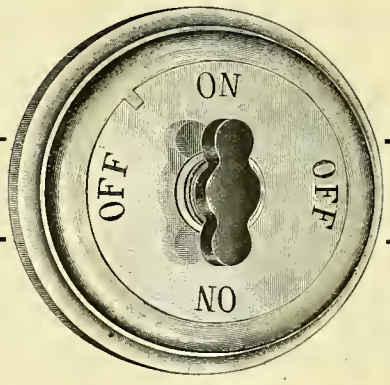

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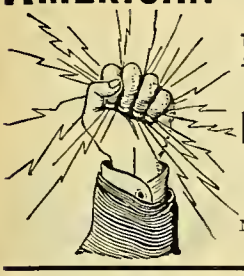

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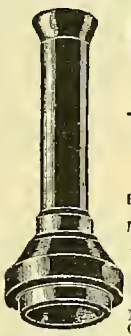

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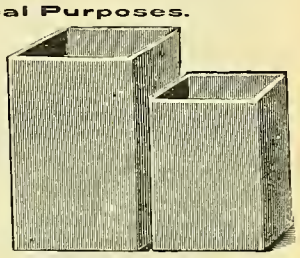

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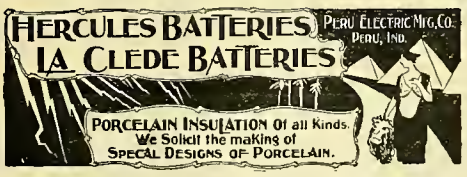

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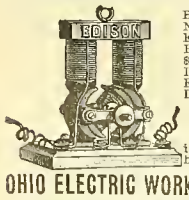

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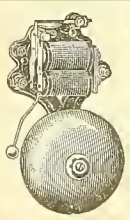

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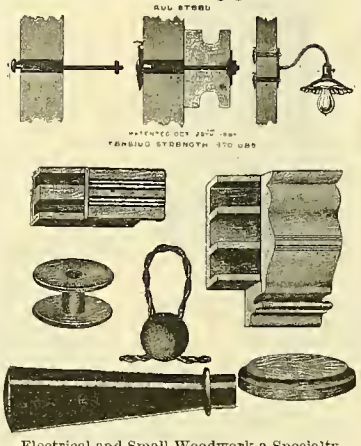

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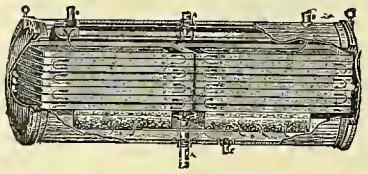

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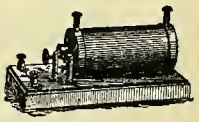

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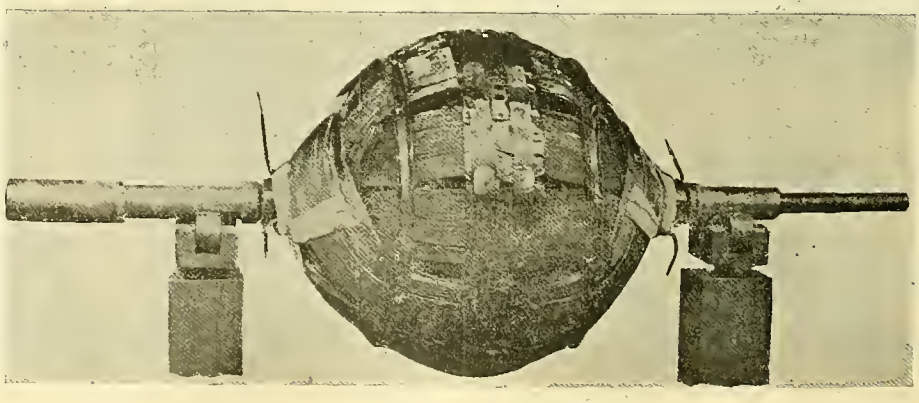

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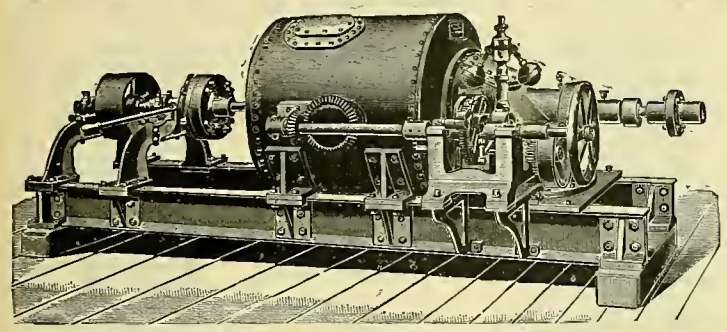

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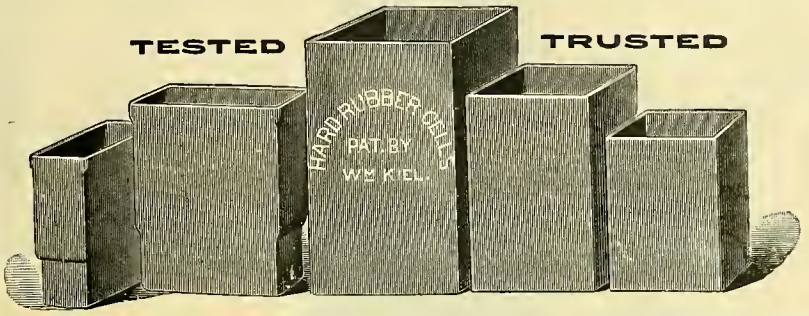

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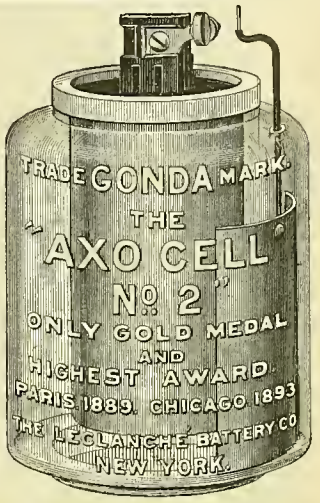

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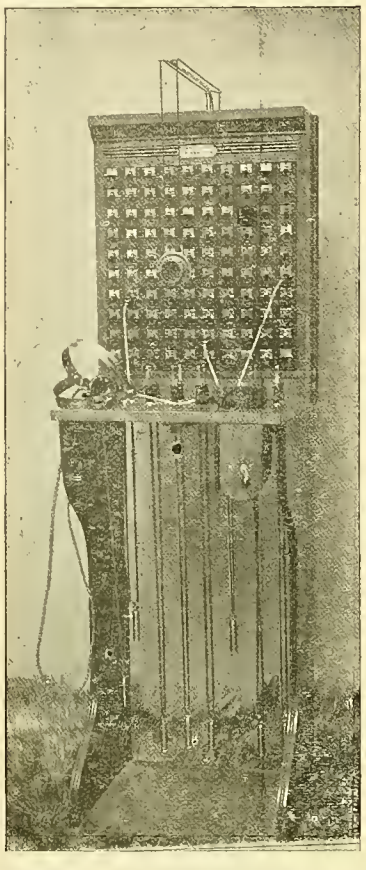

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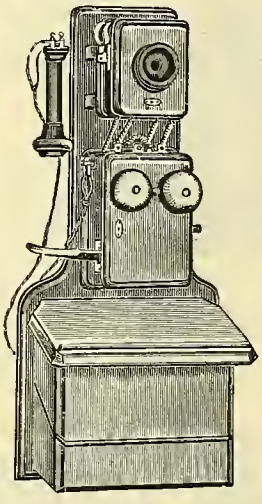

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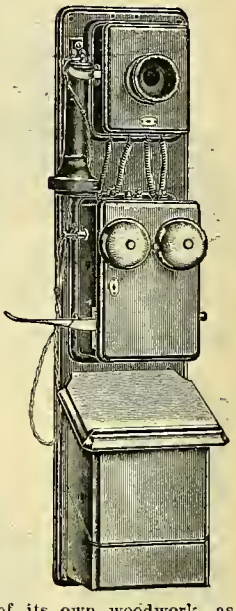

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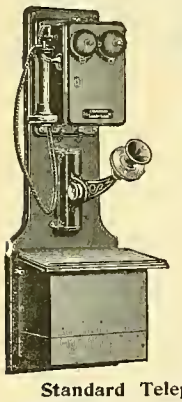

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Member of the American Institute of Electrical Engineers, and of the Institution of Electrical Engineers, London. Author of "A Practical Guide to the Testing of Insulated Wires and Cables." Joint Author of "Electricity in Daily Life."

146 Pages, 138 Illustrations, Cloth, Hand-Book Size, Price $1.00.

EXTRACT FROM PREFACE.

"This little book has no pretension to be considered a complete treatise on telephony as it exists in America. The time for such a work is not yet come. But it is felt that there is a demand for a practical book on telephone working and management, and the TELEPHONE HAND BOOK is an attempt at meeting that demand. With the exception of a few chapters dealing with certain forms of transmitters and receivers used in Europe, which are given for the information of those who may wish to engage in the manufacture of telephones, the book is based entirely on standard American practice; and most of the material, apparatus and methods described are peculiar to or have originated in this country."

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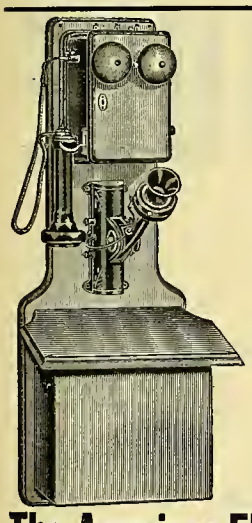

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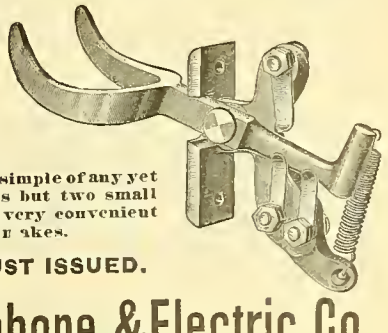

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In the interest of the development of the storage battery business these fundamental or basic patents have been acquired at great expense by **The Electric Storage Battery Company,** and users, vendors and makers of storage batteries and storage battery plates are cautioned against their infringement.

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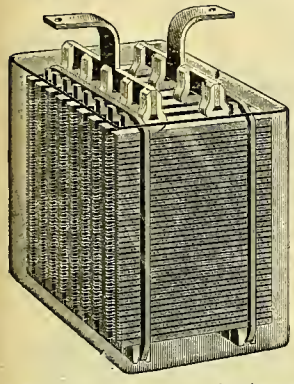
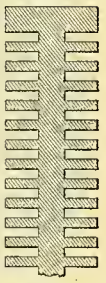
We wish to notify the public that the claims and statements made by **The Electric Storage Battery Co.,** of Philadelphia, that our plate infringes their patents, are **utterly false,** and cannot be substantiated.

The **"American"** plate is made from a solid sheet of rolled lead one-half inch thick, grooved on both sides as shown in cut. These grooves are 1-16 inch wide, and the projecting ribs are 1-16 inch thick. This is a style of plate which **Brush,** in Patent No. 266,090, partially described in claim No. 12, and which was afterward disclaimed by the patentee for want of patentable novelty.



The "active material" or peroxide of lead is formed electro-chemically by immersing the plate in a strongly oxidizing solution, which attacks the surface of the plate and completely fills the grooves with strongly adherent peroxide of lead.



No red lead, paste or other material is applied to the plate. We therefore do not infringe their patent No. 337,299.

The **"Chloride"** plate of the **Electric Storage Battery Co.** is about one-fourth inch thick and has for its active material pellets of peroxide of lead formed from chloride of zinc and lead. These pellets are about three-fourths inch in diameter, and form about one-half the surface of the plate. In the manufacture of the latter, the pellets are arranged in a mould and a lead antimony alloy is poured around their edges.

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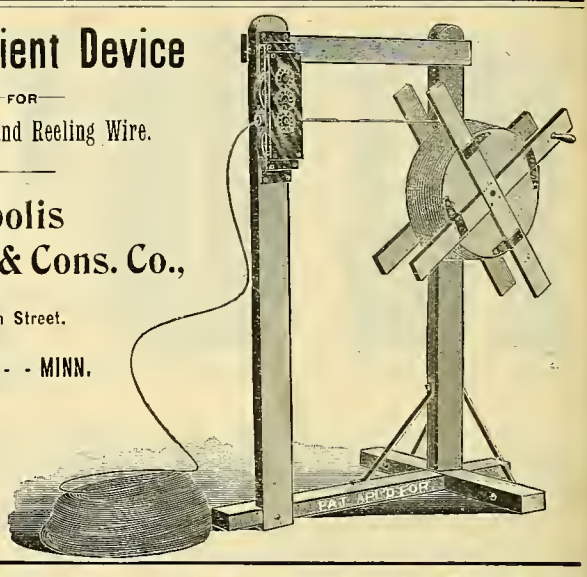

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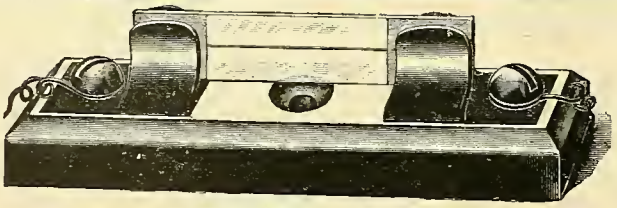

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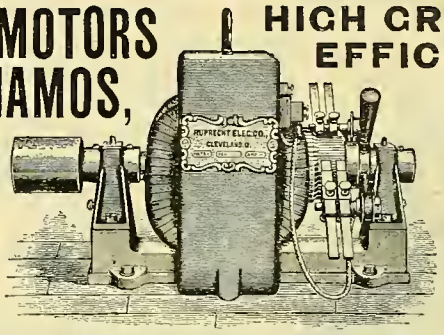

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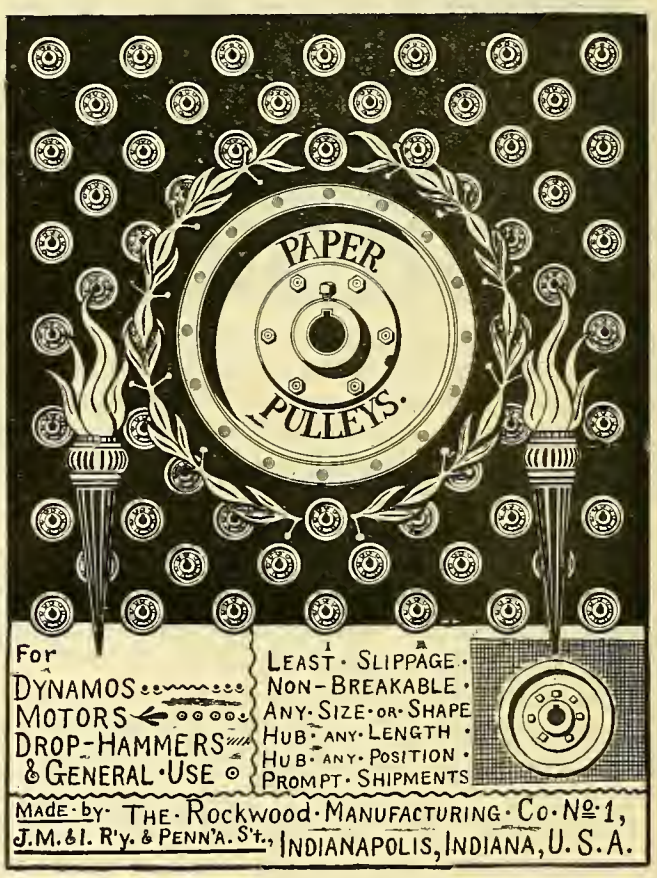

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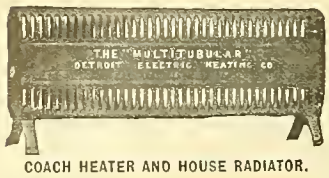

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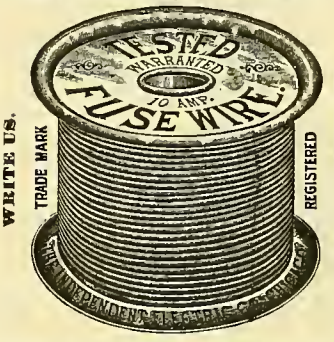

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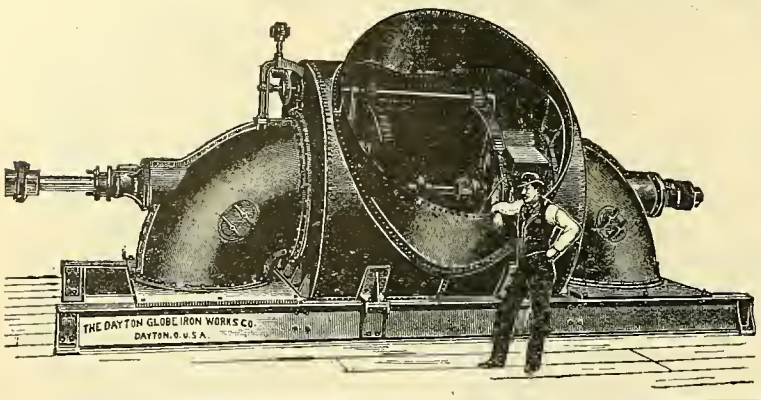

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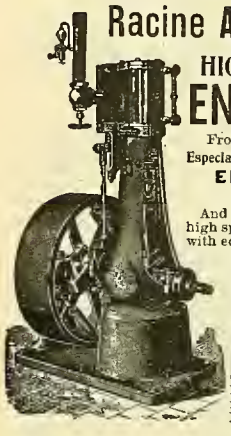

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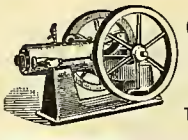

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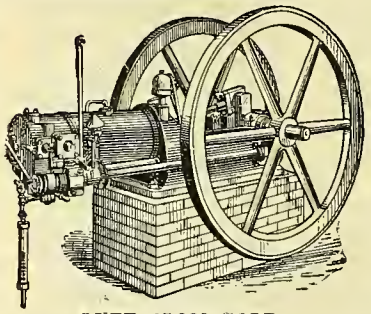

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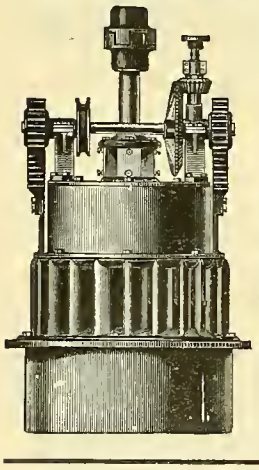

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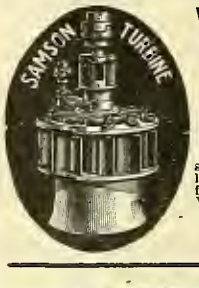

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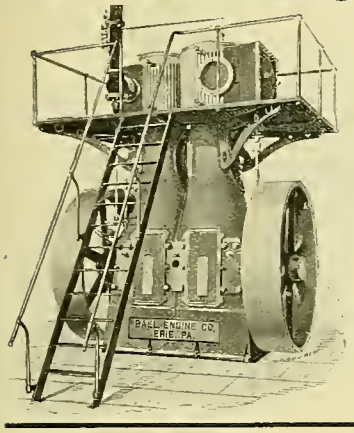

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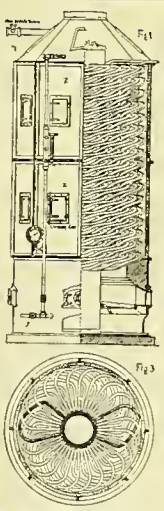

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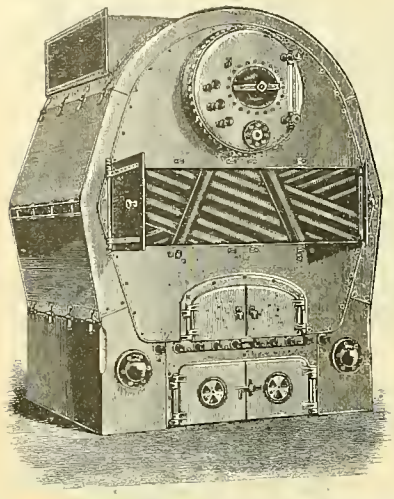

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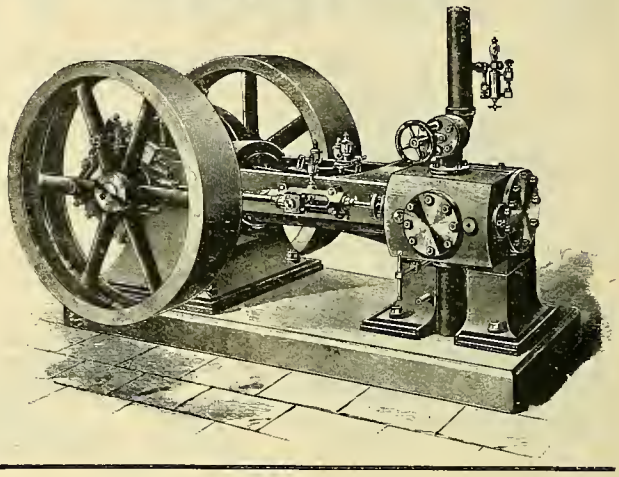

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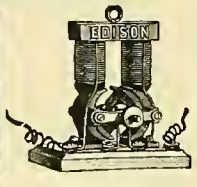

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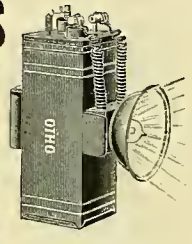

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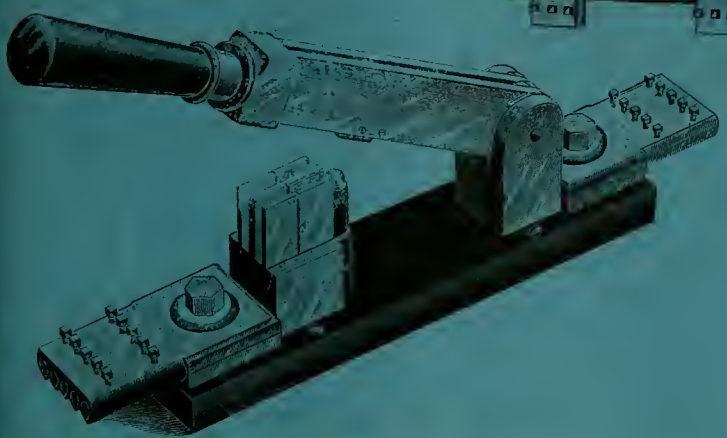

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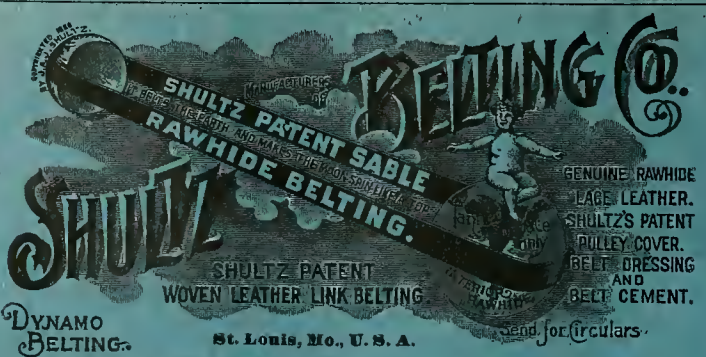

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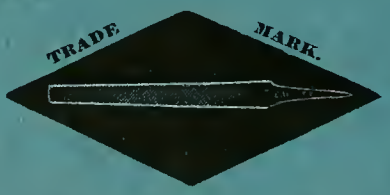

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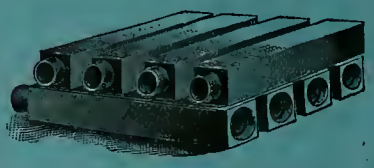

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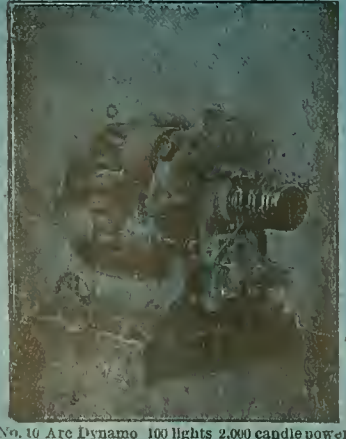
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For Aerial, Submarine and Underground Use.

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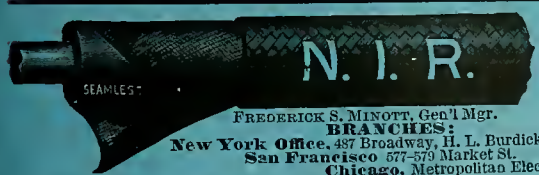

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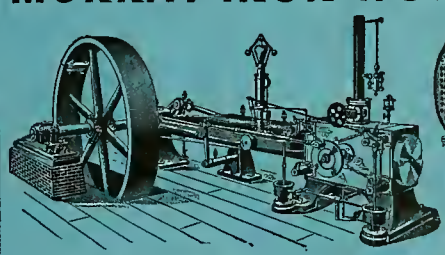

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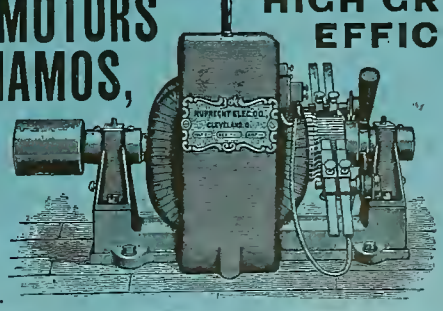

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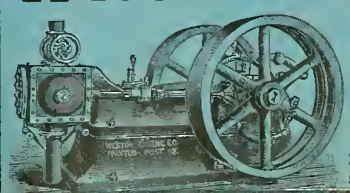

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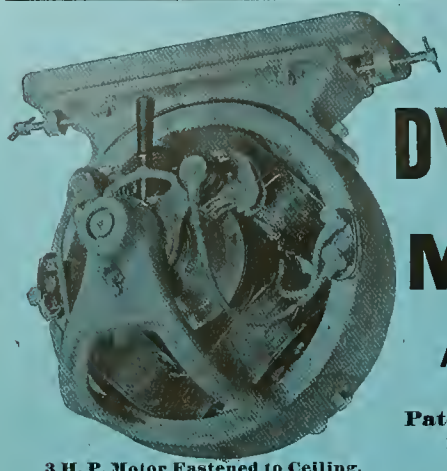

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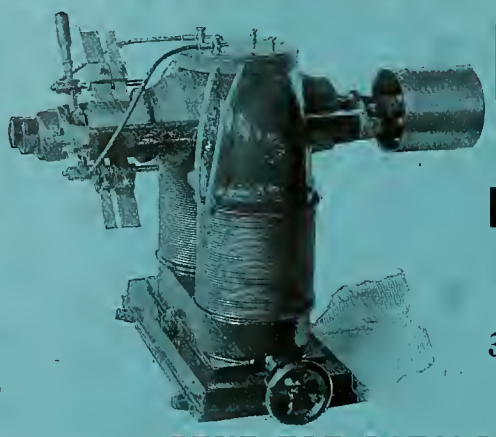

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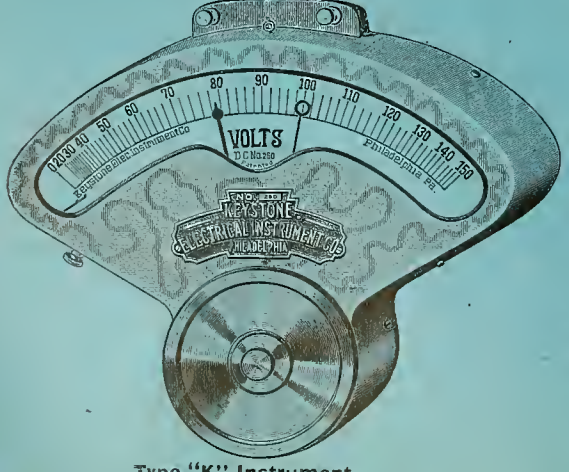

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Switchboard Voltmeters, Ammeters, Ground Detectors and Differential Voltmeters.

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating current circuits.
Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.
We can interest you in prices and other details if you will write to

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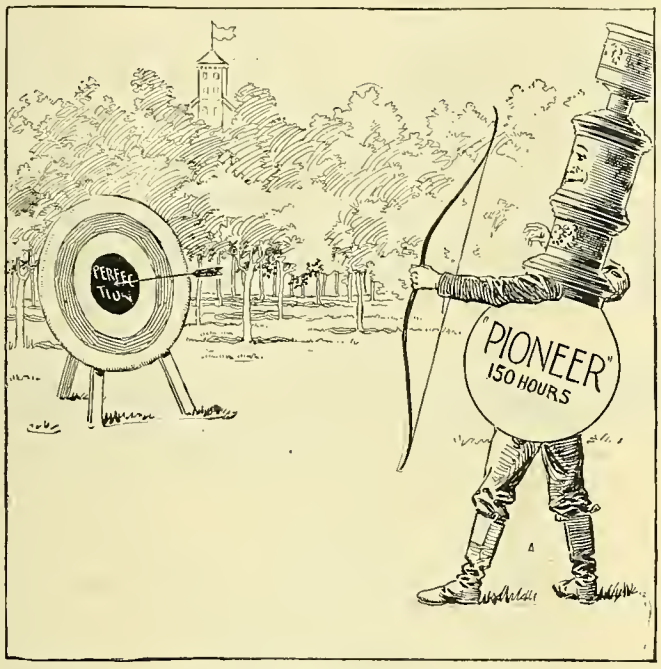

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The best light.

Softest, steadiest and whitest.

The mechanism simplest.

The operation safest and most economical.

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CHIEF ELECTRICIAN.

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PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — TRADE MARK

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A PERFECT CLUTCH.

No chance for the rods to jam. No parts to be continually renewed. Has a finer adjustment than any other clutch and consequently a saving of current is the result. Can be applied to Brush as well as T.-H lamps. We also manufacture

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J. B. McKeague, Agt.
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Robert Knickerbocker, Chief Eng.

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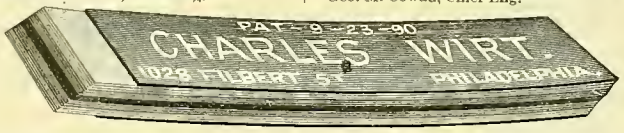
Dear Sir:—Please deliver to us twenty more Wirt Brushes, ⅞x⅞x8, and oblige,
AUDITORIUM HOTEL.
Geo. M. Cowan, Chief Eng.



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Charles Wirt. Patentee and Sole Maker, Factory, Philadelphia.

HARRY M. SHAW, 126 Liberty Street, NEW YORK.

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AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

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We furnish complete electric light plants for factories, mills, office buildings, steamboats. Experienced men sent to all parts of the country to do construction work, etc. He also

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ELECTRICAL

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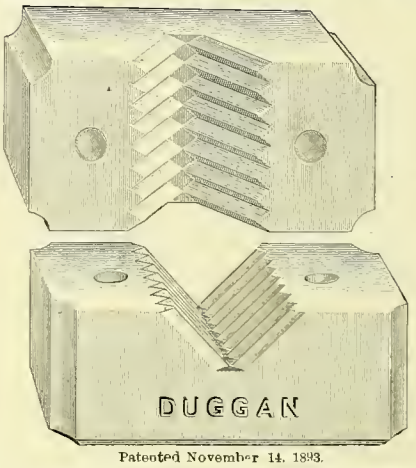
Carried constantly on hand and all orders filled promptly. Our telephones can't be beat. Give us a trial.

Julius Andrae & Sons Co., - Milwaukee, Wis.

THE DUGGAN CLEAT

LEADS THEM ALL.



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Made in one wire No. 4, 6 and 6.
Two wire No. 2 and 3.
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They are corrugated and V-shaped groove.

They grip like a vise.

No sagging wire when once stretched.

They are made of the finest glazed porcelain. Ten of them used to one of any other make.

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Factory, Trenton, N. J.
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A quick break switch, made to sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

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Tubes and Insulators,
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Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

Western Electric Company.
Chicago. New York.

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SCHEEFFER'S WATT-METERS.

DIAMOND ELECTRIC CO.,

Manufacturers,

PEORIA, ILLS., U. S. A.

SCHEEFFER'S NEW TRANSFORMER.

WATT-METERS.

We are General Agents for

WAGNER TRANSFORMERS,

And carry a full assortment of sizes in Chicago stock ready for prompt delivery. Correspondence solicited.

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Alternating Arc Lamp.

Easy to Trim.

Write for particulars.

Immediate Shipments Can be Made.

It is Short and Ornamental.

BURNS 100 HOURS.

NOISELESS.

PURITAN

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METAL WORKING MACHINERY

OF ALL KINDS.

Universal and Plain Milling Machines, Screw Machines, Drill Presses, Hand and Engine Lathes, Turret Lathes, Planers, Shapers, Gear Cutters, Grinders, Tapping Machines, Etc.

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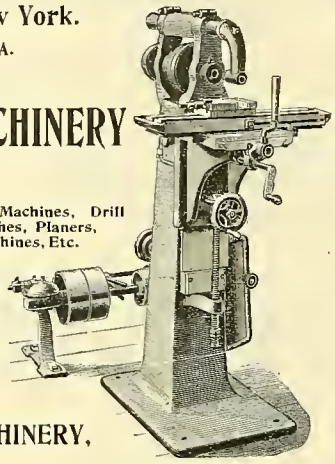
Complete plants equipped for making

ELECTRICAL GOODS AND MACHINERY,

Bicycles, Firearms, Etc.



No. 11 Milling Machine. For Small Work.

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Phillips Insulated Wire Co.
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THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

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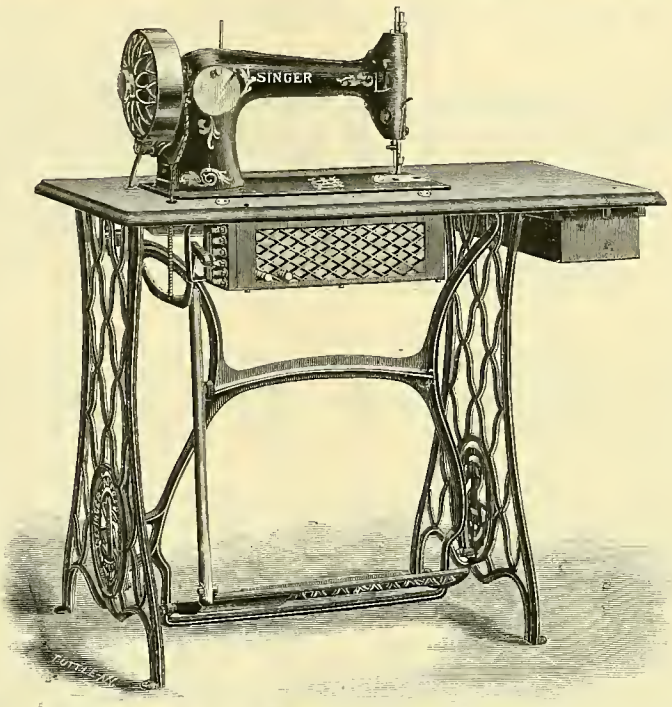
THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



IN THIS MANNER

The highest economy is attained, because all objects intervening between the source and subject of power are dispensed with and the electric current is only used when the machine is running.

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DIEHL MANUFACTURING CO.,

ELIZABETHPORT, N. J.

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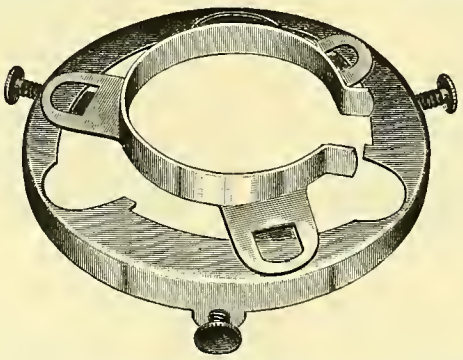
What, a Perfect Shade Holder?

YES! THE ONLY ONE THAT FITS ALL SOCKETS,
Keeping Lamp in Center of Shade Ring.

IT IS NEW AND ALL WE CLAIM FOR IT.



PURCHASE THIS, SAVE TROUBLE AND PLEASE CUSTOMERS.

No Clamp Screw. Can be Detached by Half-turn of the Hand.

Is fastened on the wedge principle; cannot get loose. Can be attached to Edison socket without removing the rubber or porcelain screw on lower end.

The Housatonic Company,

WALLINGFORD, CONN.

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THE IRON ARMORED CONDUIT SYSTEM

OF THE

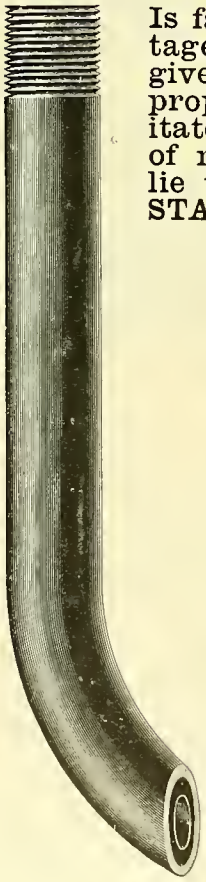
INTERIOR CONDUIT AND INSULATION CO.,

NEW YORK,

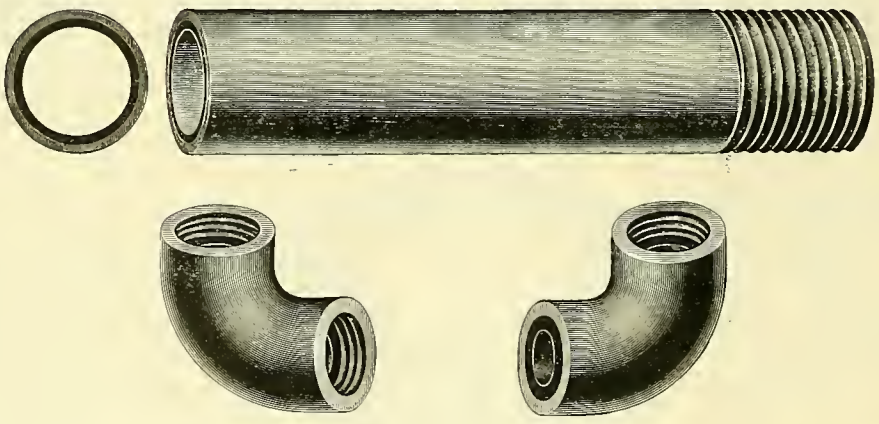
IS THE ONLY STANDARD.

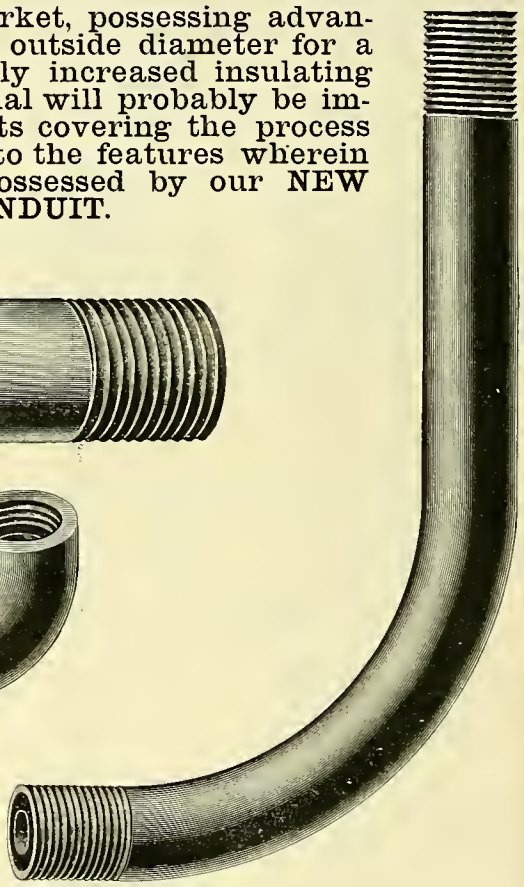
We Offer the Only Complete System of Electric Wiring.

Our New Standard Iron Armored Insulating Conduit



Is far superior to any ever placed upon the market, possessing advantages in that it is extremely light, has a smaller outside diameter for a given inside diameter, and moreover, has greatly increased insulating properties. Like all other standards, this material will probably be imitated. However, the broad, fundamental patents covering the process of manufacture prevent even a near approach to the features wherein lie the strength and integrity of insulation possessed by our NEW STANDARD IRON ARMORED INSULATING CONDUIT.





Catalogues, Samples and all information upon application.

INTERIOR CONDUIT & INSULATION CO.,

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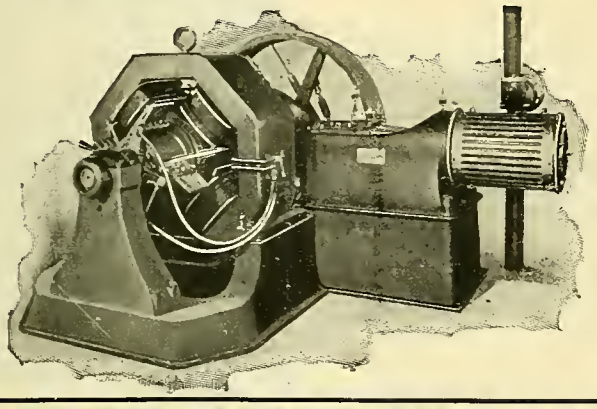
EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



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We build all neeessary apparatus for the transmission of Electrieal Power through faetory or other buildings.

The Eddy Electric Mfg. Co.,

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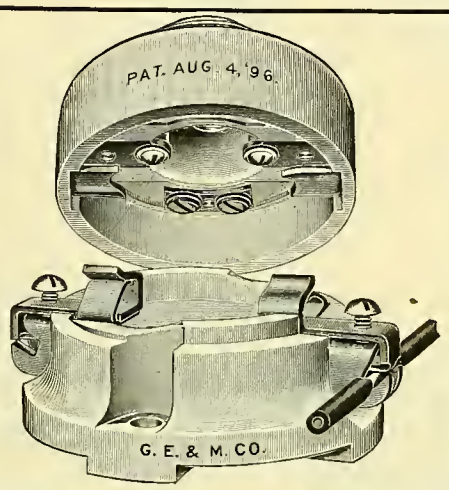
INTERIOR CONDUIT

(CUMMING'S PATENTS.)

Note how the Wood-Lining does not crack.

ARMORITE INTERIOR CONDUIT CO., OFFICE AND WORKS, 478-488 FORT STREET, WEST, DETROIT, MICH.,

ELECTRIC APPLIANCE CO., Chicago, General Western Agents.



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WHY?

BECAUSE:

1st—Has perfect contact without marring softest wire.
2nd—Line wire is held by clamp instead of screw points.
3rd—It is easy to take apart; no screw driver, only a quarter turn.
4th—Can use long fuse.
5th—All that use them say so.

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ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.

Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

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Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

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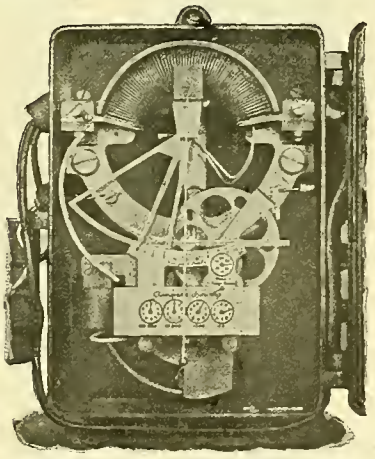
Designed for all Forms of Service.

Send for circulars and price lists.



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The . . . American Electric Meter Co.,

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OUR HIGH FREQUENCY

X-RAY COIL

Can be Relied Upon to Work at All Times.

Undisputed Supremacy.

WHAT OTHERS SAY MAY INTEREST YOU.

Messrs. L. E. KNOTT APPARATUS CO. Urbana, Ohio., August 8, 1896.

Gentlemen:—Your high frequency coil for alternating circuit is giving very satisfactory results in the Roentgen experiments. Our Medical Association has expressed its highest appreciation of the working and results of the Coil. I am safe in saying that my experiments have verified your high claims of its efficiency.

Very truly, I. N. KEYSER, Prin. Urbana High School.

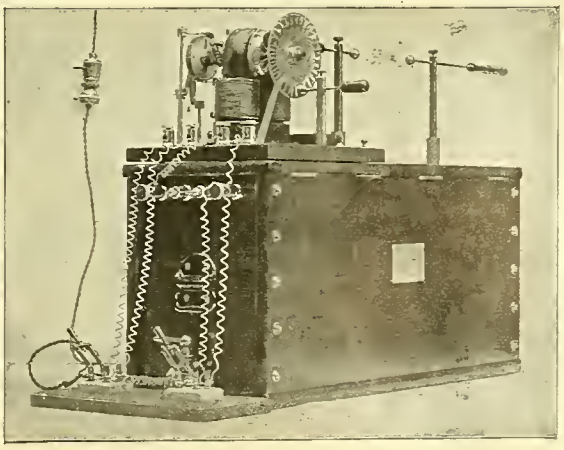
Manufacturers of High-Grade X-Ray Apparatus, mechanically and scientifically perfect.

L. E. Knott Apparatus Co.,

Microscopic, Chemical and Physical Apparatus,

14 ASHBURTON PLACE, BOSTON, MASS.

New X-Ray . . Paper, Superior to Plates.



Knott Direct Current High Frequency Coil for X-Ray Work.

IT PAID ALL THESE PEOPLE

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Why won't it pay YOU?

The Following is a List of Some of Our Customers Who Have Purchased Apparatus from Us within the Past Few Months.

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W. F Brooks .... Butte, Mont.
Kenosha Light & Power Co .... Kenosha, Wis.
Woonsocket Elec. Mach. & Power Co.... Woonsocket, R. I.
Chattanooga Coffin & Casket Co .... Chattanooga, Tenn.
Cadiz Electric Light & Power Co. .... Cadiz, Ohio
Consolidated Electric Co .... Chicago
Ed. S. Saunders .... Muscatine, Iowa
W. E. Macdonald .... Geneva, Ill.
Chas. Lorring .... Chicago
Price & Keith .... Chicago
Crystal Falls Electric Co. .... Crystal Falls, Mich.
Bevington, Langton E. S. & C. Co. .... Pittsburg, Pa.
H. D. Kendall .... Enosburg Falls, Vt.
Osburn Electric Supply Co .... Chicago
Sosman & Landis. .... Chicago
Dearborn Electric Co .... Chicago
Illinois Eastern Hospital .... Kankakee, Ill.
P. A. Thompson .... Chicago
Phillipsburg El. Light, Gas & Power Co ... Phillipsburg, Pa.
New Berlin Light & Power Co. .... New Berlin, N. Y.
Geneva Electric Lighting Co. .... Geneva, Ohio
J. E. Putnam .... Salina, Kas.
F. H. Stewart & Co. .... Philadelphia, Pa.
Gallipolis Electric Light & Power Co. .... Gallipolis, Ohio
Belton Electric Co. .... Belton, Tex.
W. B. Conkey & Co. .... Chicago
C. F. Gunther .... Chicago
S. H. Light & Son .... North Star, Ohio
Biggio Bros .... Chicago
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Charles E. Gregory Co .... Chicago
Hartley Electric Works .... Chicago
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Roslyn Electric Light Co. .... Roslyn, Wash.
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Ligonier Electric Light Co .... Ligonier, Ind.
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Dexter Building .... Chicago
Municipal Electric Plant .... Clinton, Mich.
Marienthal Bros .... Chicago
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Olive Branch Electric Light Co .... Ferguson, Mo.
W. E. Sworden .... Liberty Centre, Ohio
Billings Water Power Co. .... Billings, Mont.
J. G. Schmohl .... Galena, Ill
Adolph Hamacik .... Sturgeon Bay, Wis
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Chicago Illuminating Co. .... Chicago
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Why won't it pay YOU?

Why won't it pay YOU?

TRY US

You may make money by it, and a trial will only cost a postage stamp.

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28						

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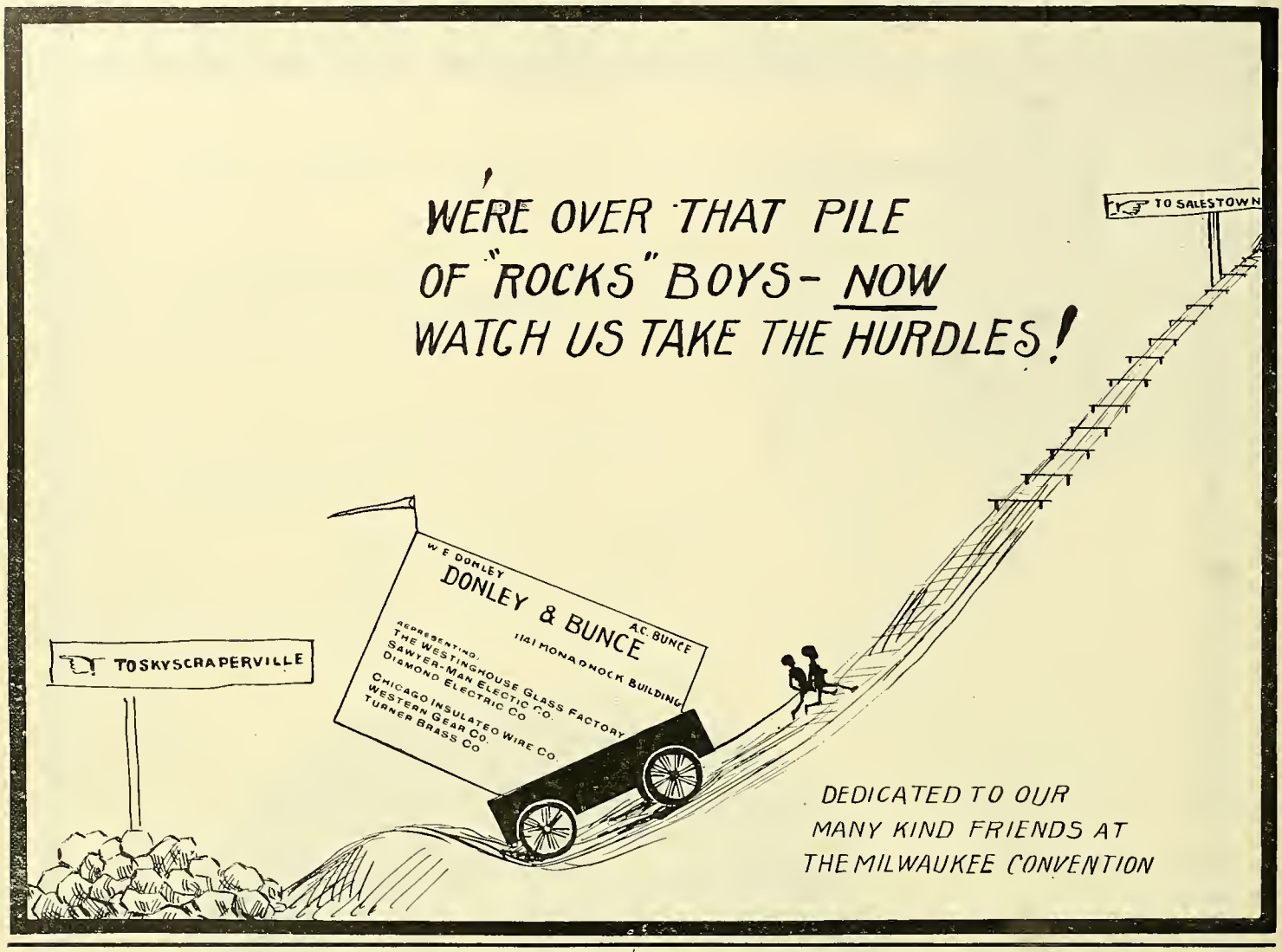
"My boy, listen to 'Willie' and 'The Old Man' —

"You're young yet and blinded but there'll come a time when you'll see why we tied up with the Commercial Electrical Supply Co. of St. Louis — They're 'good people' — throw off those goggles, my boy, and give 'em a trial."



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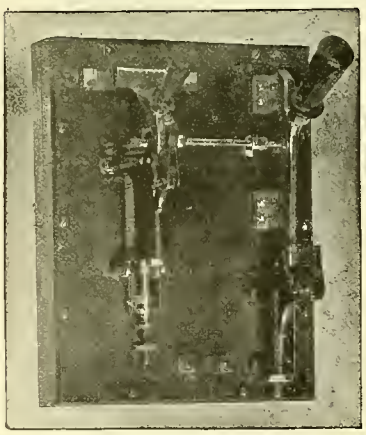
Machine Circuit-Breaker.

Long Desired Relief for Central Stations.



Adapted to Any Make of Alternating Machine.

READ THE FOLLOWING ENDORSEMENT:

BOSTON ELECTRIC LIGHT COMPANY,
BOSTON, MASS., Nov. 17, 1896.

MR. L. L. ELDEN.

DEAR SIR:—The alternating machine circuit-breakers purchased of you two years ago have proved to be all that you claimed for them. We have not lost a single armature from short circuits or lightning in any of our stations since we equipped our dynamos with the breakers, and there seems to be no possible trouble on the dynamos or circuits that this device will not handle instantly. They have saved us many times their cost, and we consider them the best insurance that we could possibly place on our alternating plant. No station manager can afford to run a station without them if he uses the alternating system, as one visit by lightning or one short circuit will do more damage than many times the cost of the circuit breakers. Should be very glad to have you refer any one to us for our experience.

Yours truly,
BOSTON ELECTRIC LIGHT COMPANY,
F. A. Gilbert, Pres. and Mgr.

Agents wanted in leading cities. SELLS ON SIGHT. Circular and prices on application.

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NEW EIGHT-STORY PLANT OF GERMANIA PRINTING CO. MILWAUKEE, WIS.

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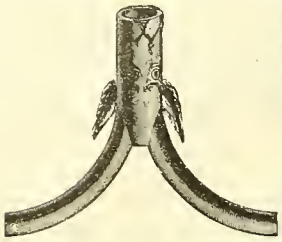

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We carry in Chicago a complete stock of Armorite fittings; such as couplings, elbows, junction boxes, outlet boxes, etc.

Our stock of Armorite Iron Armored Interior Conduit is the largest stock of iron armored conduit carried in the West. We can fill an order for 100 feet or for a carload promptly from Chicago.

Remember that Armorite is the

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interior conduit on the market in every sense of the word.

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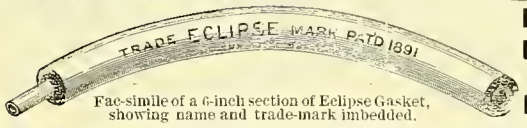

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FOR UNIONS, HANDHOLES AND MANHOLES.

PATENTED AND MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MANUFACTURING CO.,

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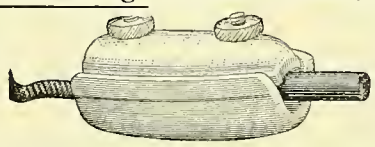
THE NEW "BUG."

Reynolds' "Self-Insulating" Cut-Out. Small, Simple, Safe.



ACTUAL SIZE.

No cover required. Insulation effected *with* the connection. It cannot "ground" the fixture. Quickly adjusted. Tape useless. Cheaper and smaller than any covered "Bug" on the market, and wholly different. Complies with Underwriters' requirements. **For sale by all Supply Houses.**

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THE MOST THOROUGH INSULATOR.

INSURES PERFECT SATISFACTION.

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Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.

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Is the only article that will **prevent sparking.** Will keep the Commutator in good condition and **prevent cutting. Absolutely will not gum the brushes. Endorsed by all users. Ask your Supply House for "GALE'S" and take no other.**

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Reports:

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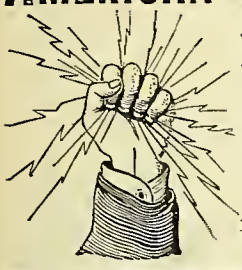

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The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

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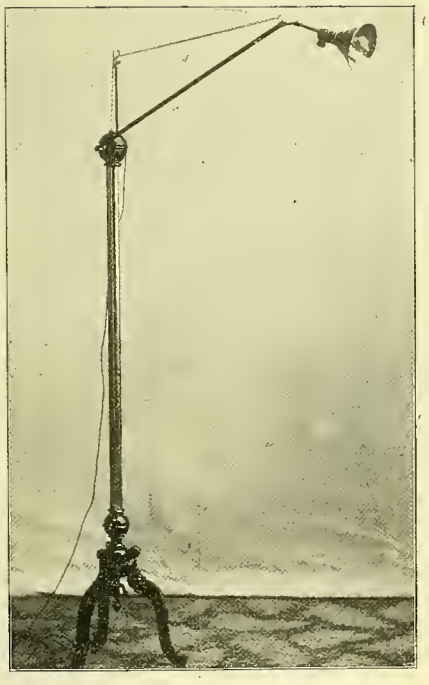
61-63 Hampshire Street, BOSTON, MASS.

Dental and Surgical Lamp



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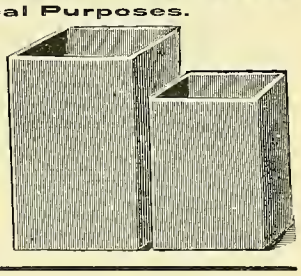

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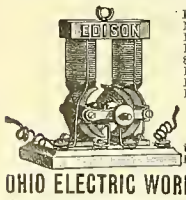

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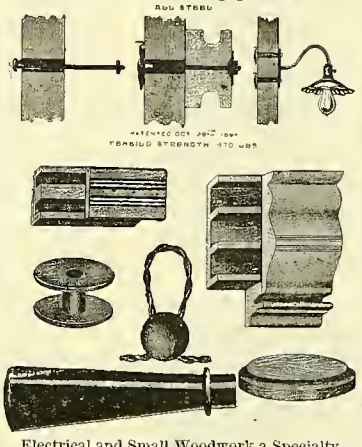

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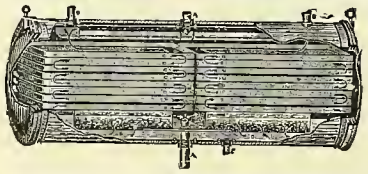

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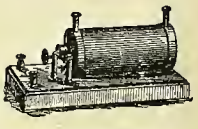

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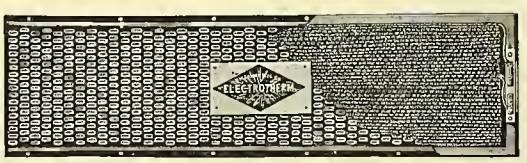

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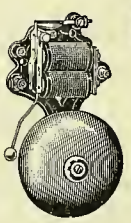

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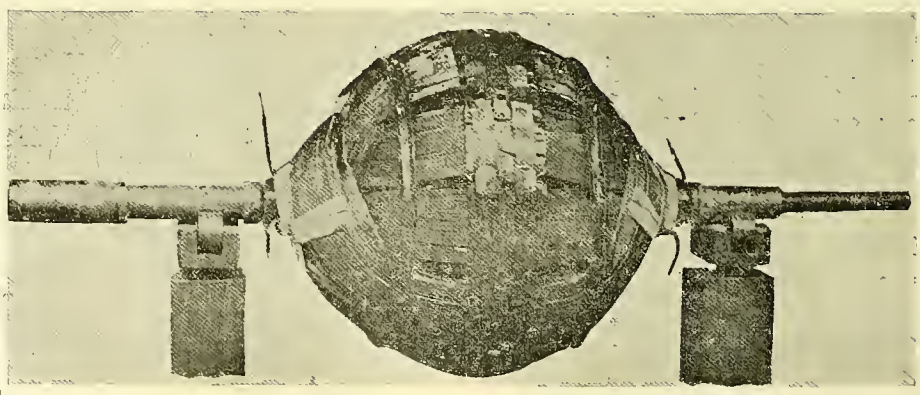

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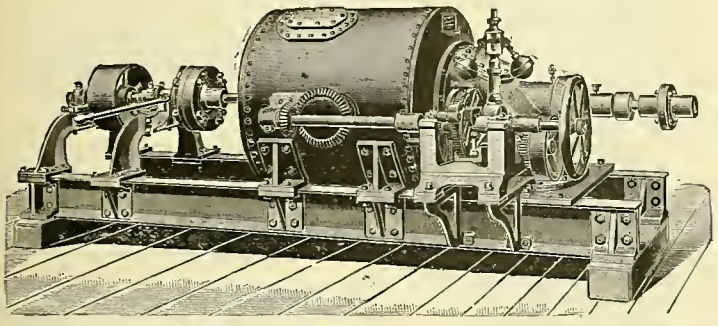

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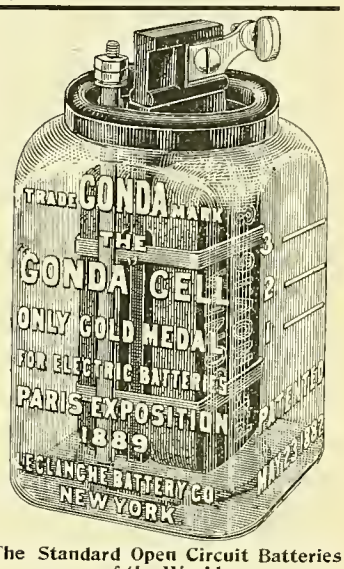

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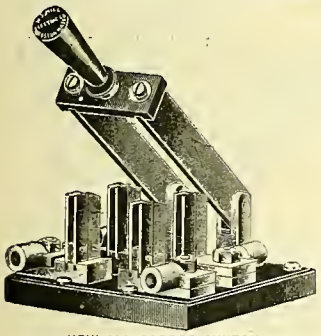

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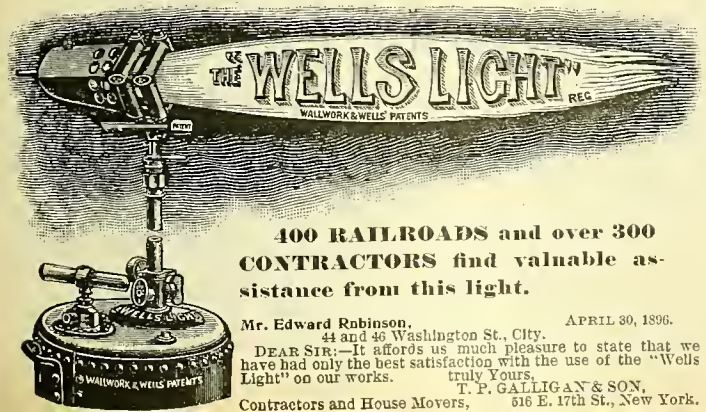

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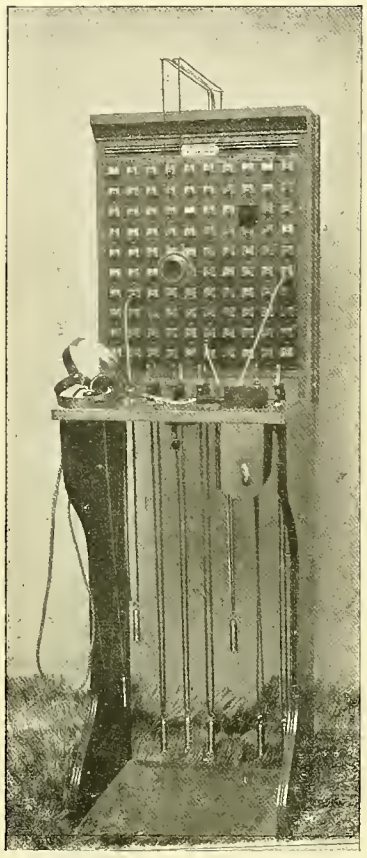

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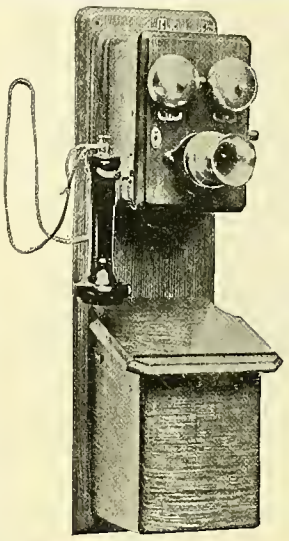

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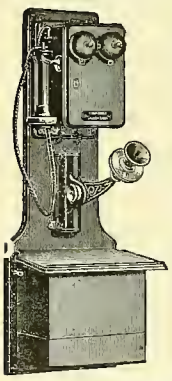

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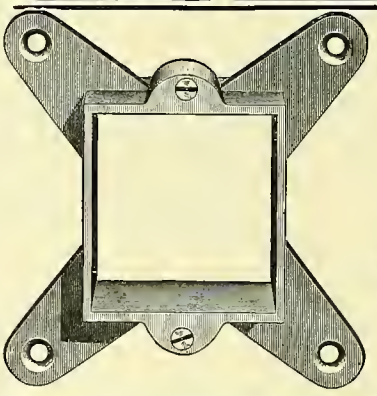

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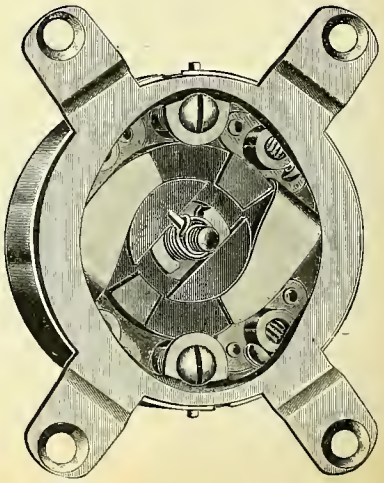

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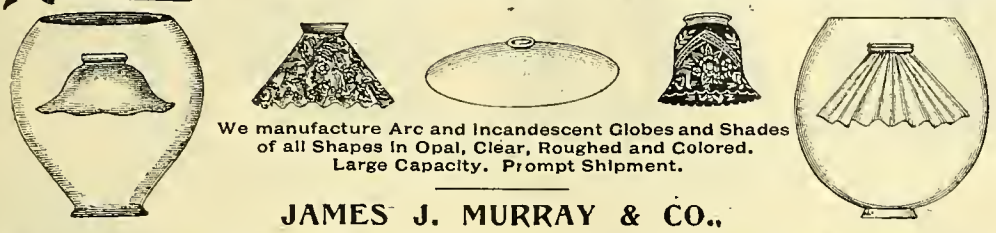

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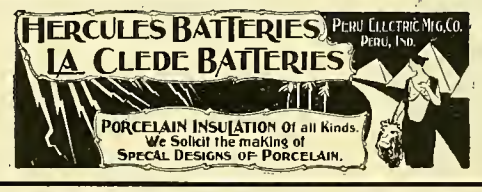

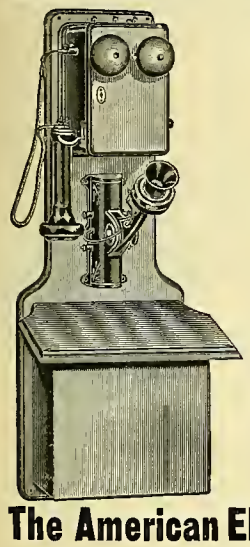

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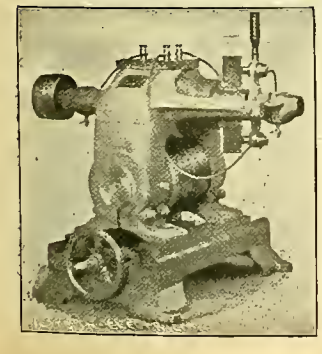

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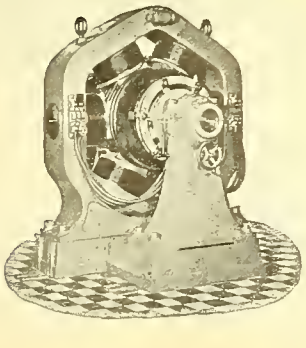

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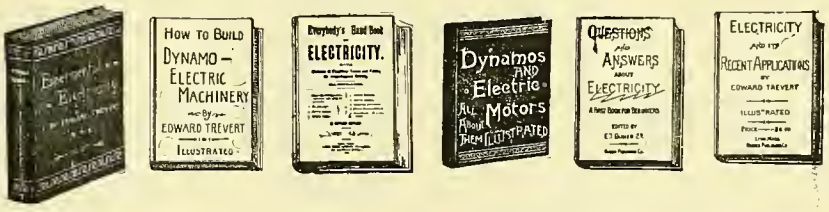

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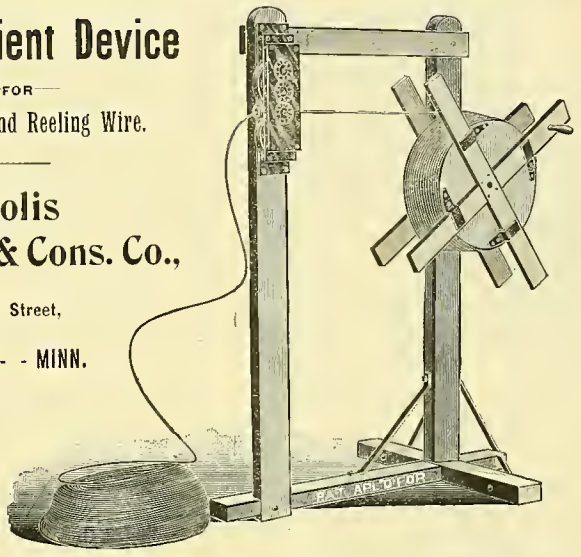

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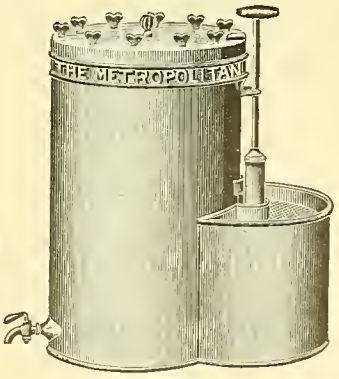

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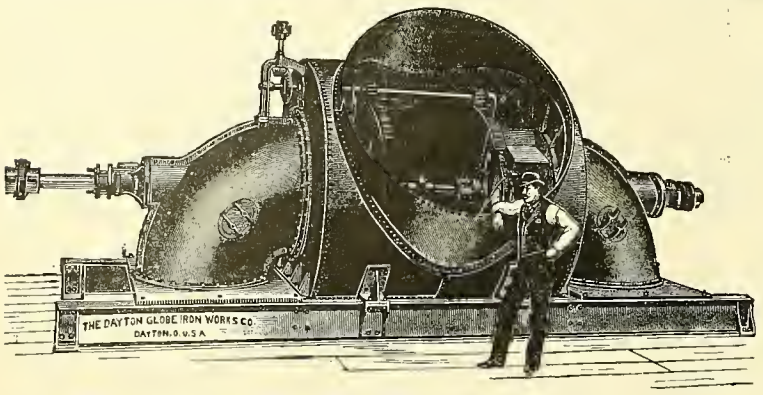

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⅝ "	17.03	111.83	98.12	149.99	79.31
½ "	16.88	118.67	82.07	118.40	75.52

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⅞ "	16.56	134.80	120.85	188.14	83.09
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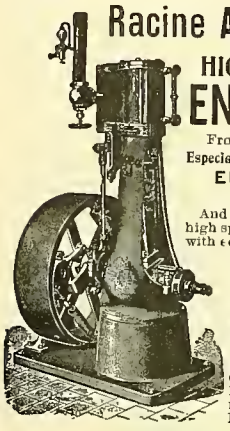

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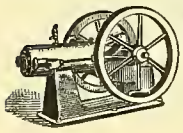

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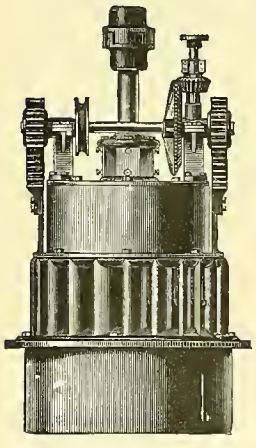

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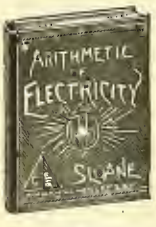

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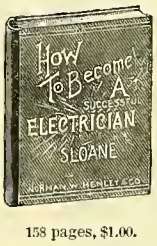

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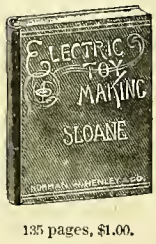

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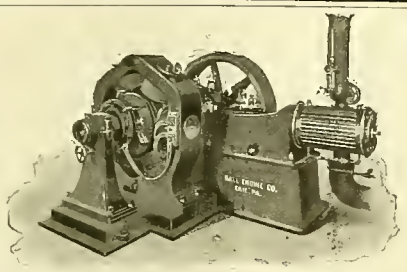

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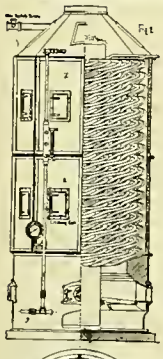

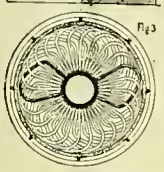

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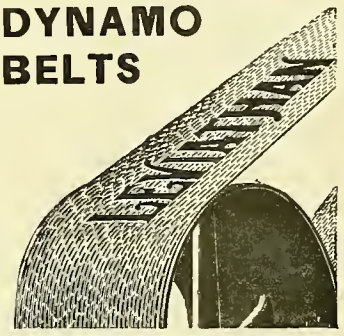

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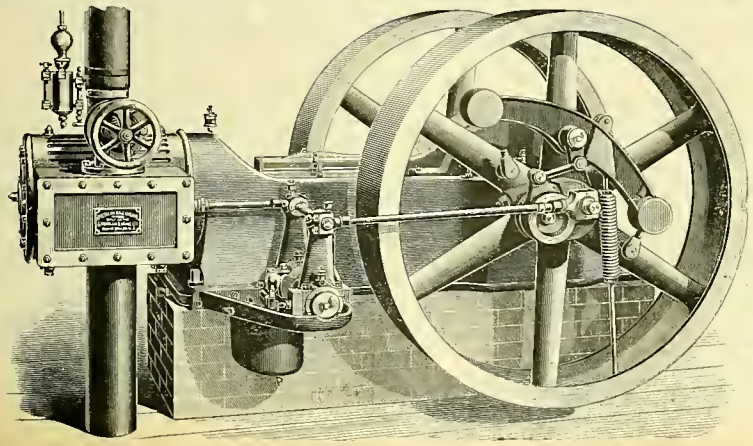

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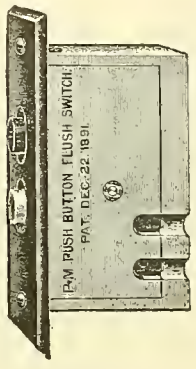

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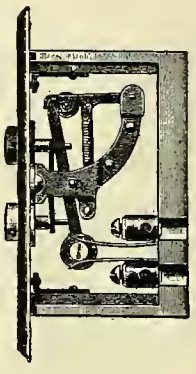

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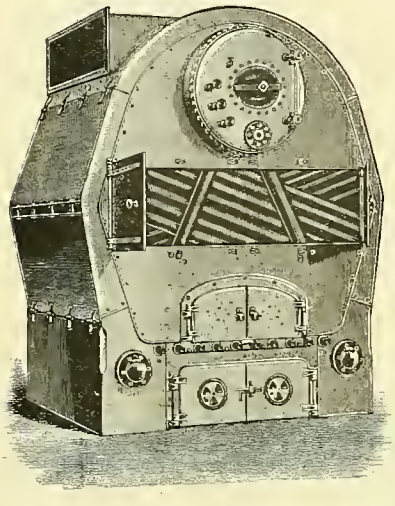

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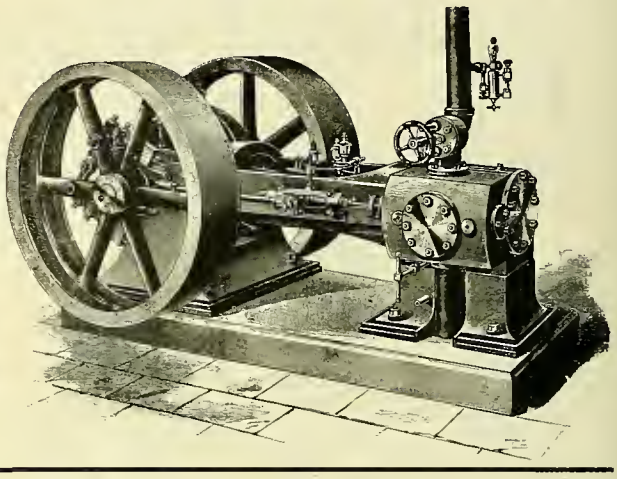

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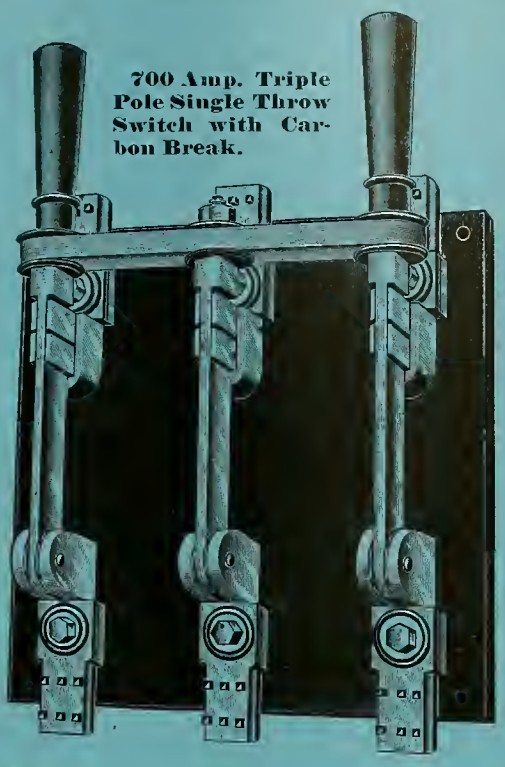

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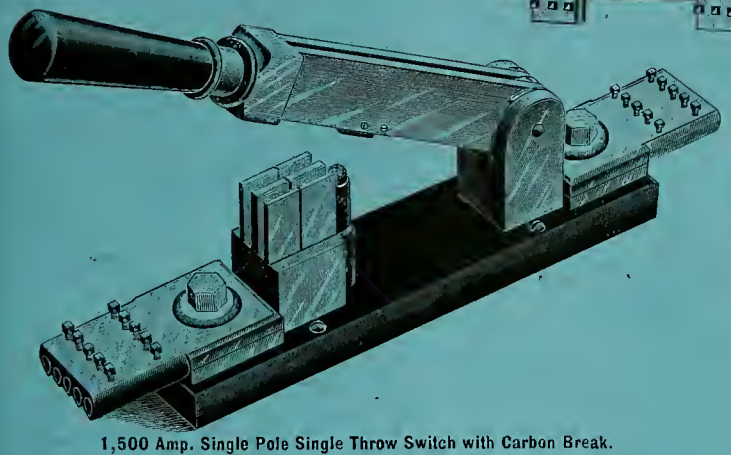

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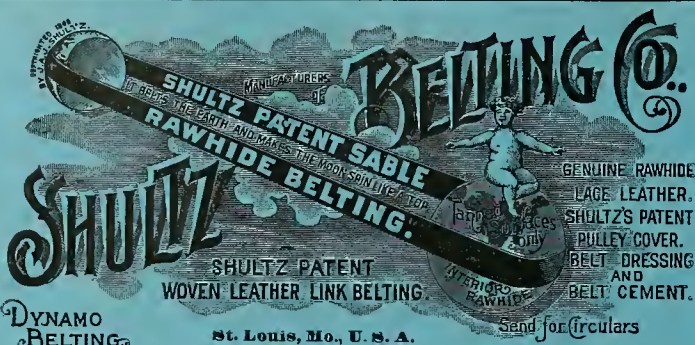

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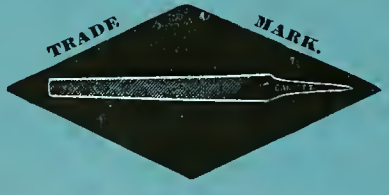

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Vol. XX. CHICAGO, FEBRUARY 6, 1897. No. 6

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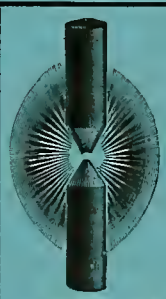

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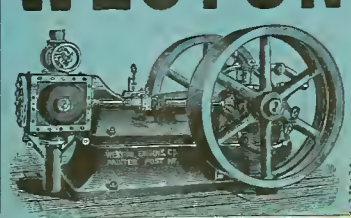

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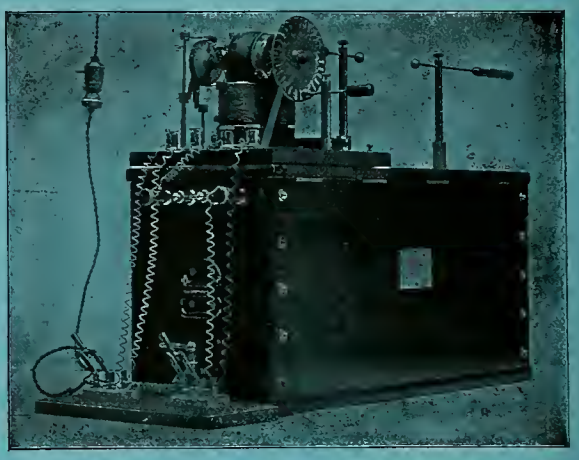

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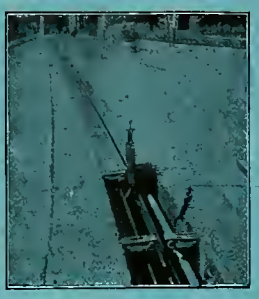

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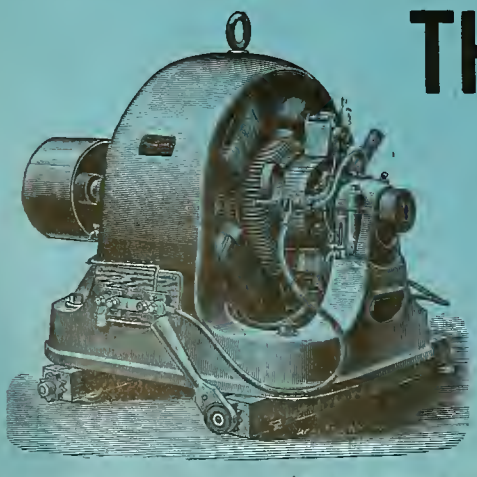

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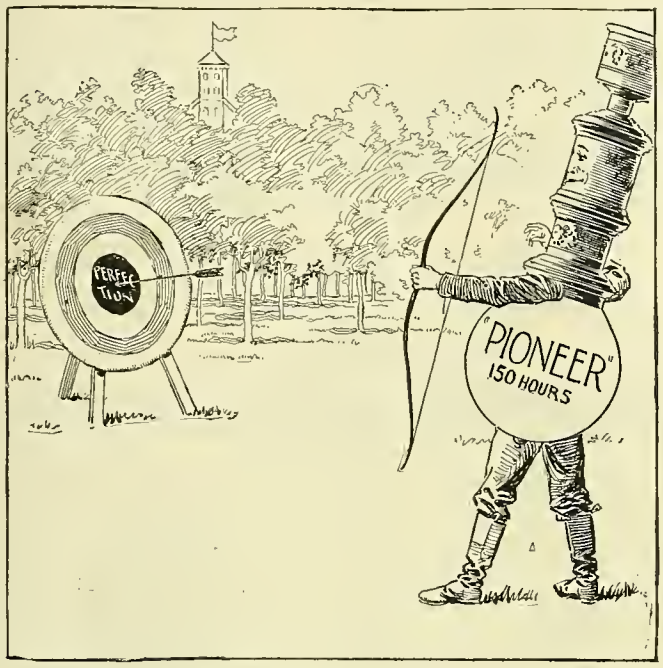

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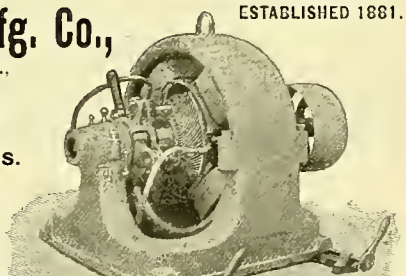

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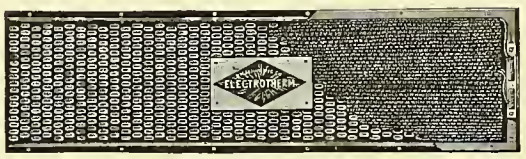

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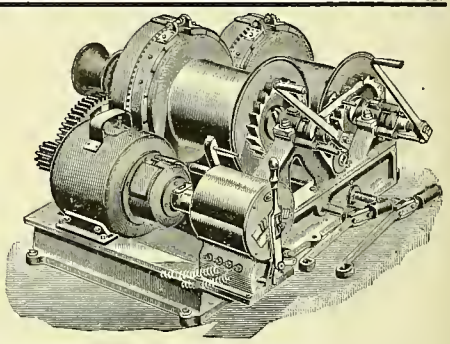

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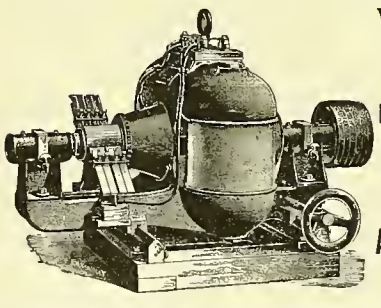

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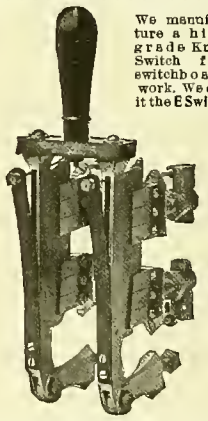

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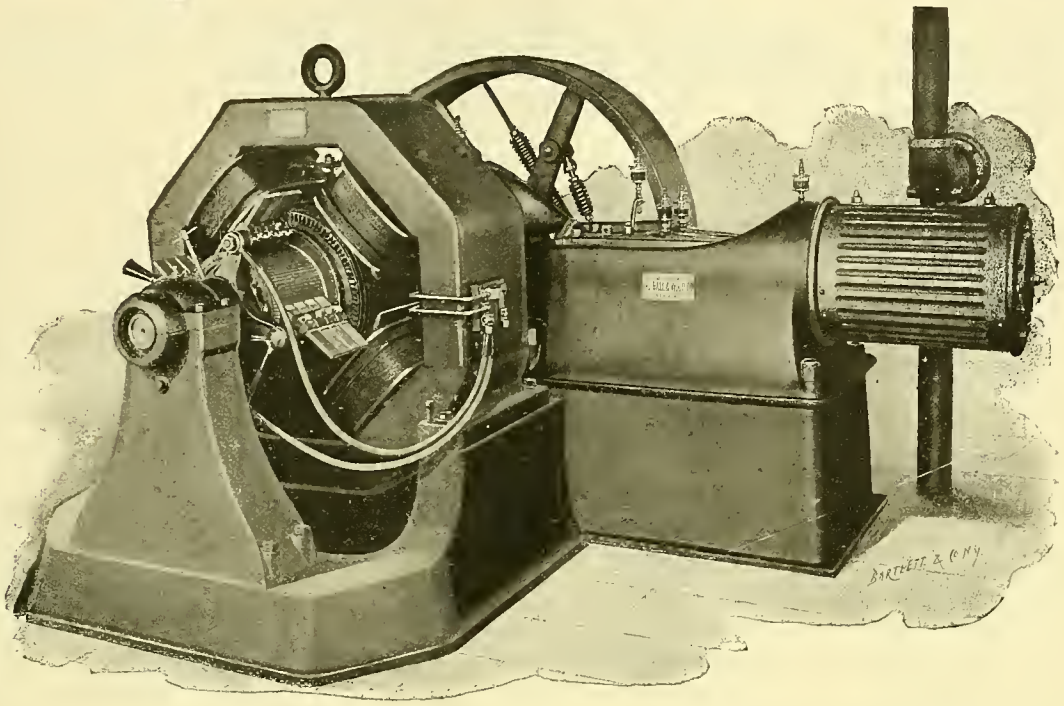

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

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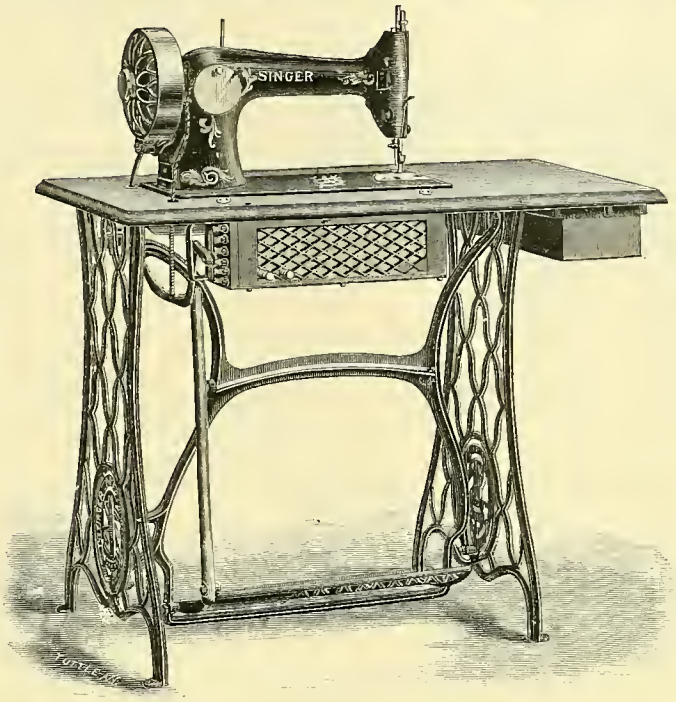
THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

MOTORS are entirely **SELF-CONTAINED** and replace the ordinary balance wheels.

THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



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The highest economy is attained, because all objects intervening between the source and subject of power are dispensed with and the electric current is only used when the machine is running.

Write for catalogue.

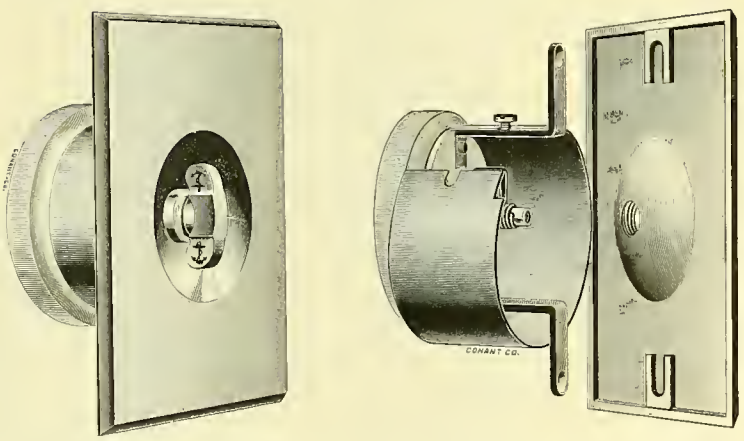
DIEHL MANUFACTURING CO.,

ELIZABETHPORT, N. J.

SHOWROOMS: 561-563 BROADWAY, NEW YORK CITY; 128-132 ESSEX STREET, BOSTON.

"**LITTLE WILLIE**" and the "**OLD MAN**" have been starring all over the country lately. They're resting now, so they'll not tell you this week what they know about the peculiarly valuable features of

ANCHOR SWITCHES



AND OTHER . . . .

ANCHOR SPECIALTIES

The plate is made of heavy metal which admits of a high finish.

The handle is so designed as to be practically flush.

A spring beneath the handle makes the plate absolutely rigid.

By simply loosening one screw the shell may be removed for wiring.

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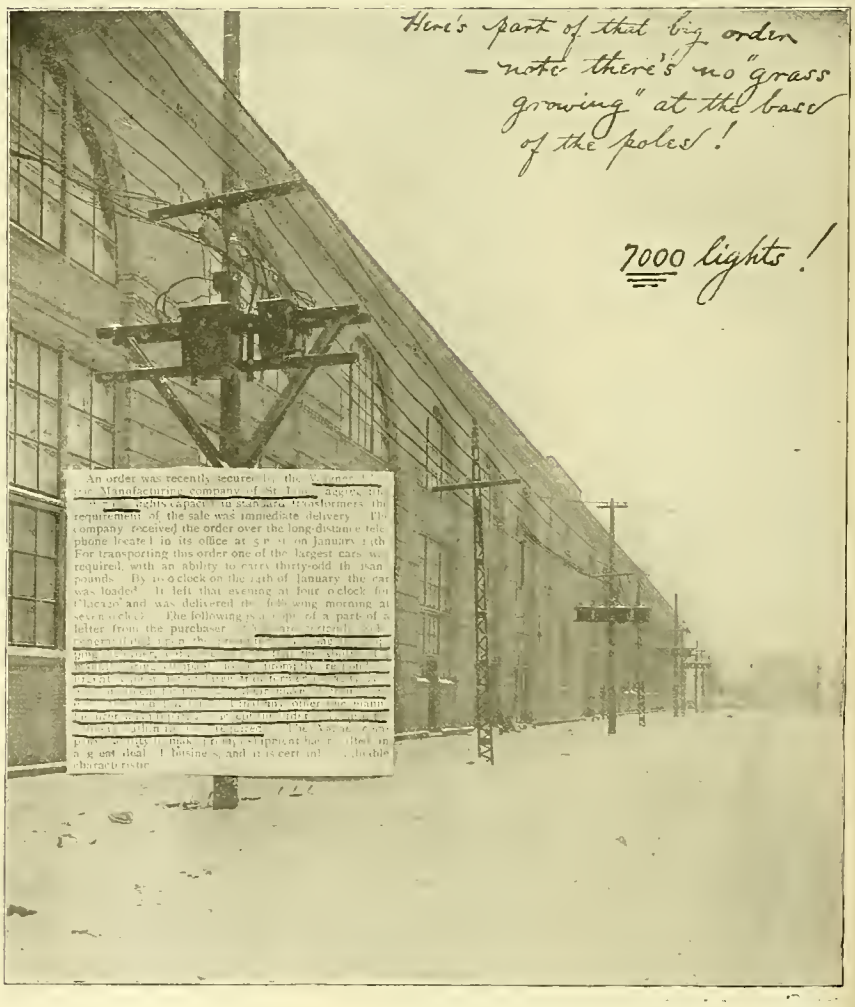
THE COMMERCIAL ELECTRICAL SUPPLY COMPANY,

ST. LOUIS, MO.

AN ILLUSTRATED STORY

(WITH A MORAL).



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ELECTRA ·TRADE MARK·

HIGH GRADE NUERNBERG CARBONS

ELECTRA ·TRADE MARK·

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

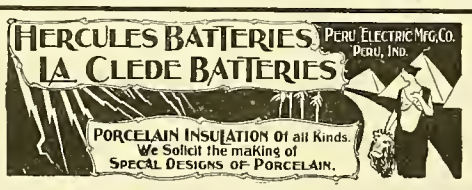
HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

DIXON'S BELT DRESSING

AND LEATHER PRESERVATIVE.

Is guaranteed to prevent slipping and to preserve the leather.
It will pay you to send for circulars and testimonials.

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.



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MANUFACTURERS OF

All kinds of

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CAR HEATER NO. 1, COVER REMOVED.

COACH HEATER AND HOUSE RADIATOR.

The "Multitubular" Heaters for Motor Cars, Cabins, Staterooms, Show Windows, Portable Stoves, etc. Cooking Apparatus, Laundry Irons, Water Heaters, Ovens and Evaporators. . . . . .

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writes a customer about "The Dealer's Assortment" of electric heating appliances sent with a showcase for $25.67. We have made radical improvements in electric heating devices, which are conspicuous. If you have not done so, order one of the "Dealer's Assortments" and be up to date. Everything guaranteed.

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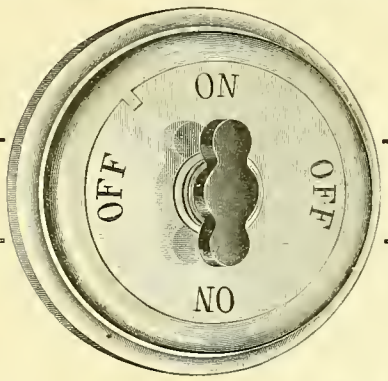
FOR ELECTRIC CAR HEATERS.

10 AMPERE, SINGLE POLE, 500 VOLT.

DIAMETER OF BASE, THREE INCHES.



BREAKS CIRCUIT AT FOUR POINTS.

THE HART & HEGEMAN MFG. CO.,

HARTFORD, CONN.

OUR CALENDAR and MOONLIGHT SCHEDULE

For 1897 is a very useful and ornamental addition to any office. We have tried to supply all of our customers and the electrical trade in the west with copies, but some have undoubtedly been overlooked. We have a number of copies left which we will be glad to send out on application.

ELECTRIC APPLIANCE COMPANY,

ELECTRICAL SUPPLIES,

242 Madison Street, - - CHICAGO.

Send for Samples and Prices of

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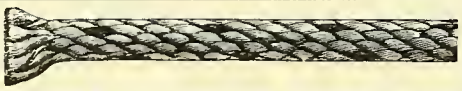

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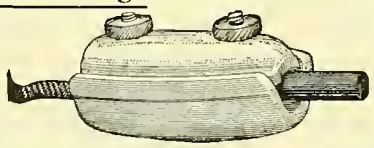

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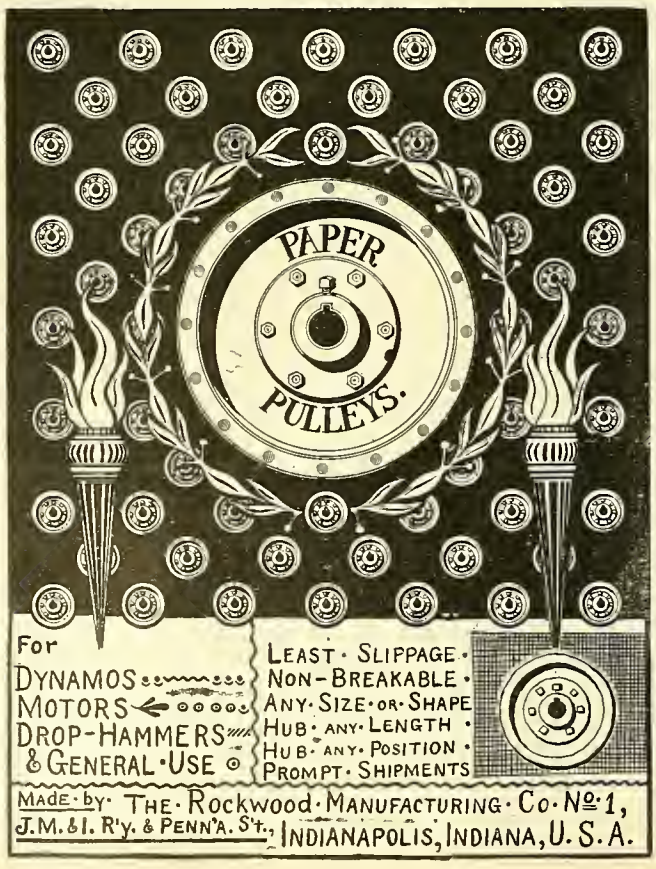

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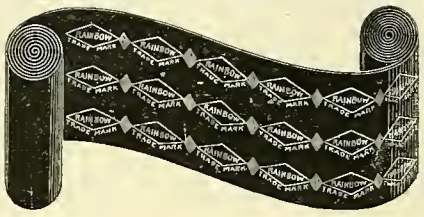

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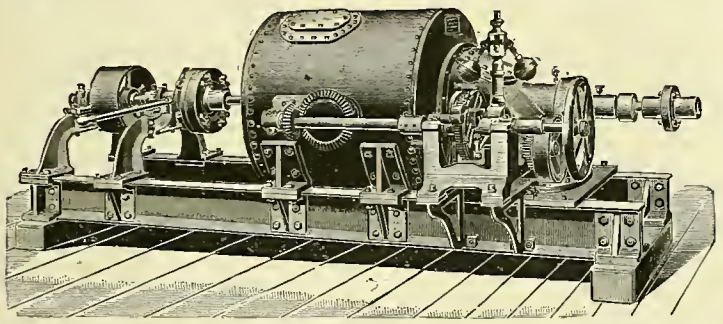

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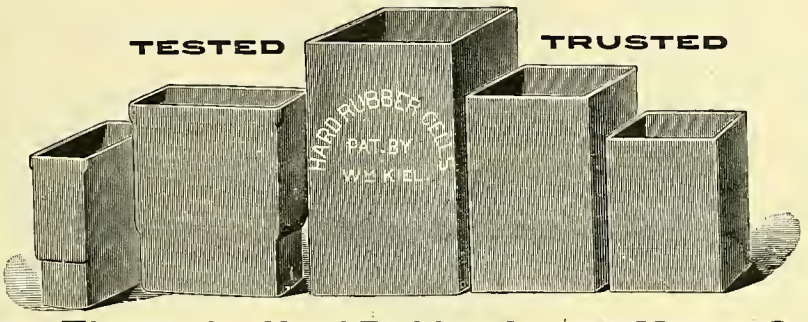

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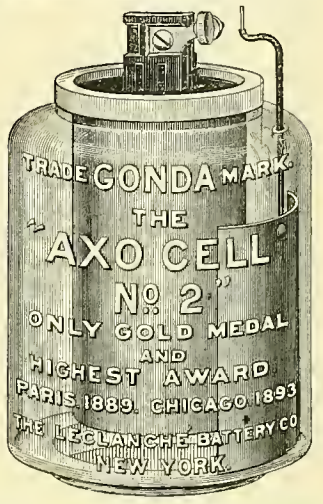

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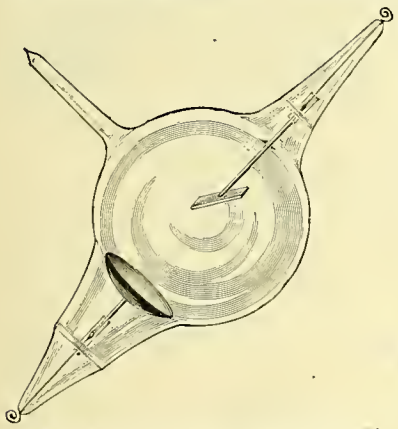

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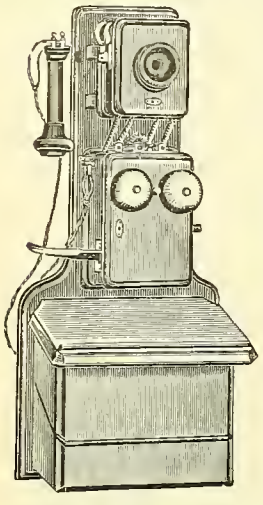

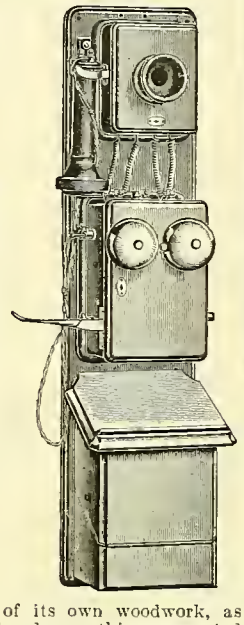

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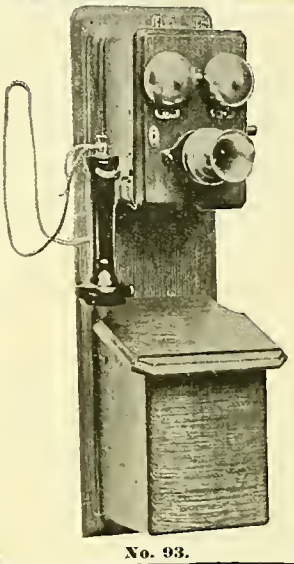

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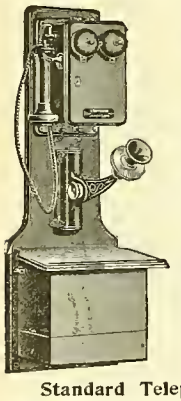

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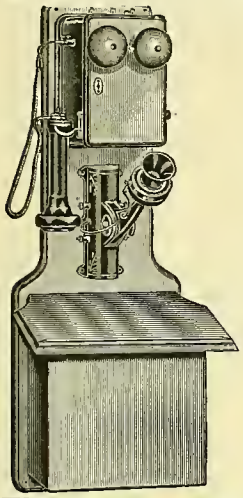

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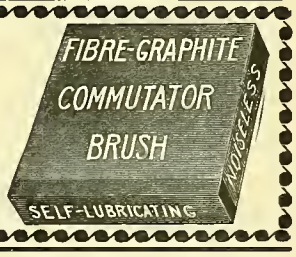

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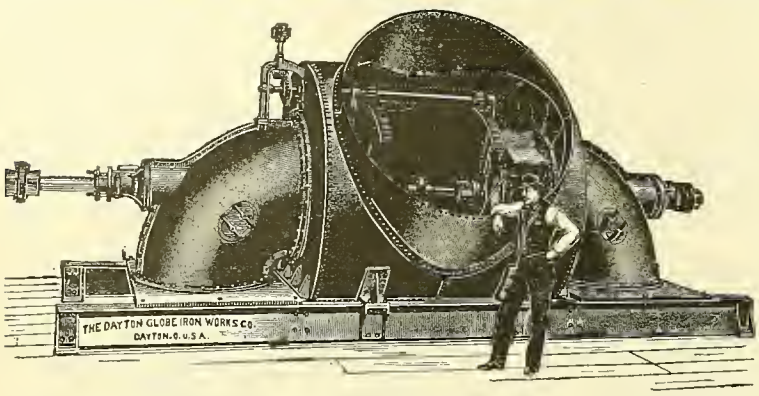

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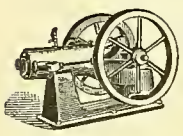

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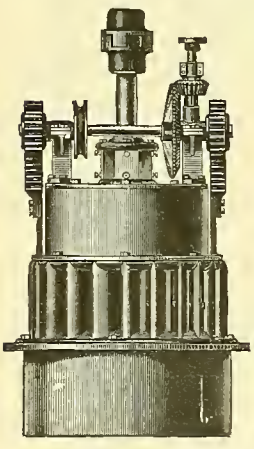

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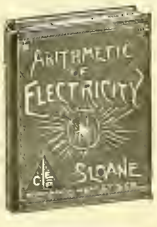

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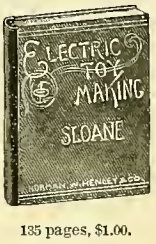

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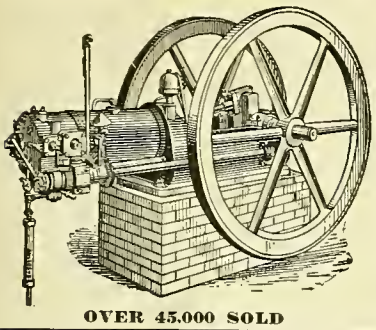

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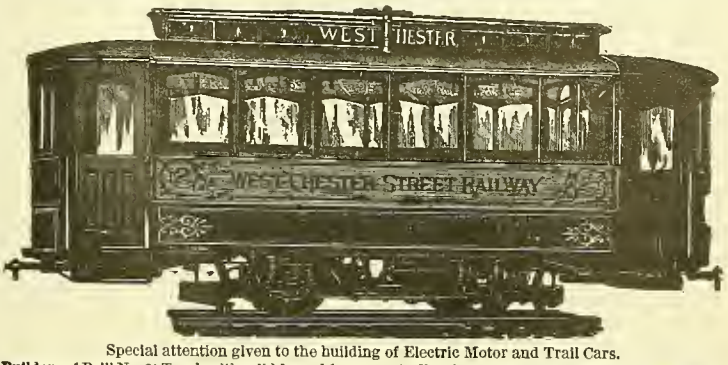

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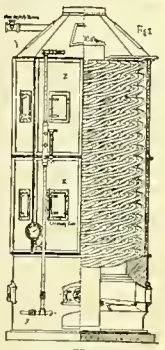

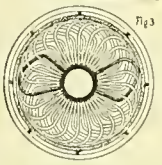

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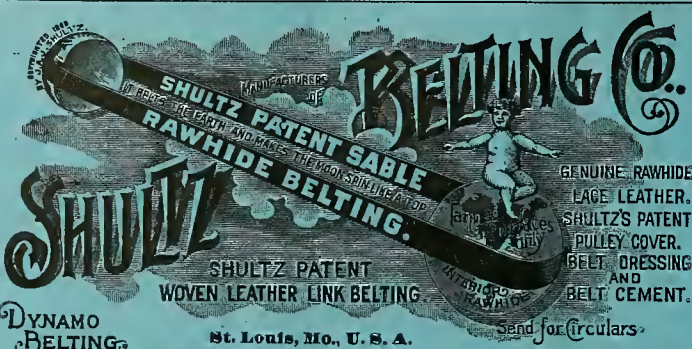

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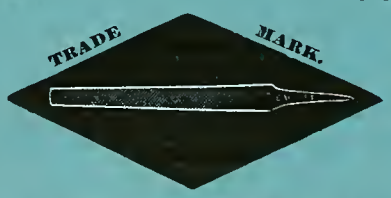

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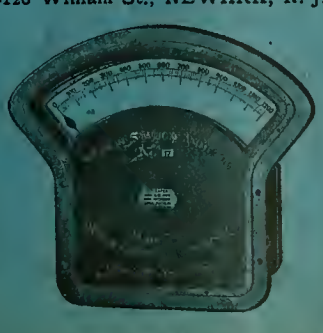

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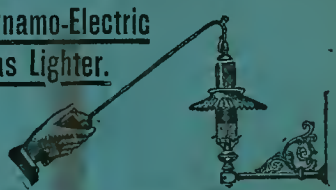

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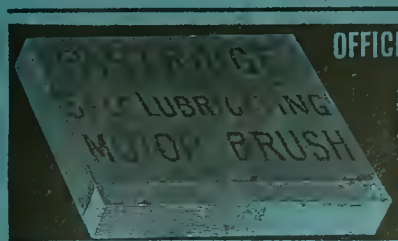

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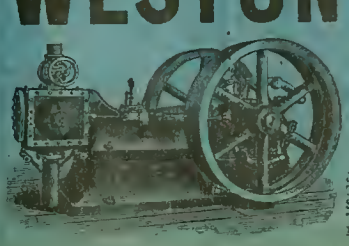

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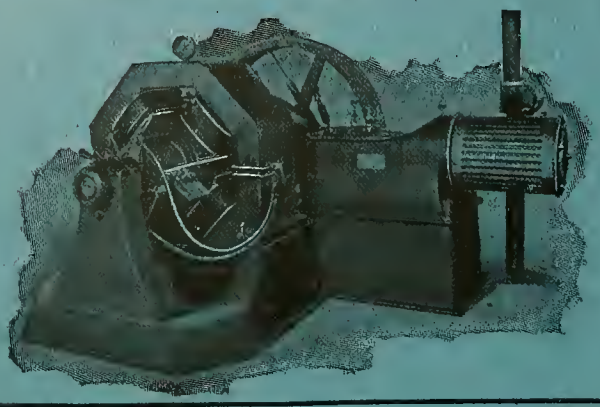

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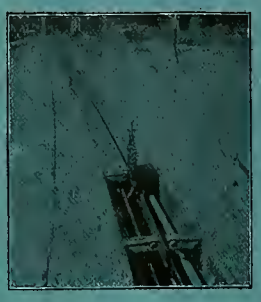

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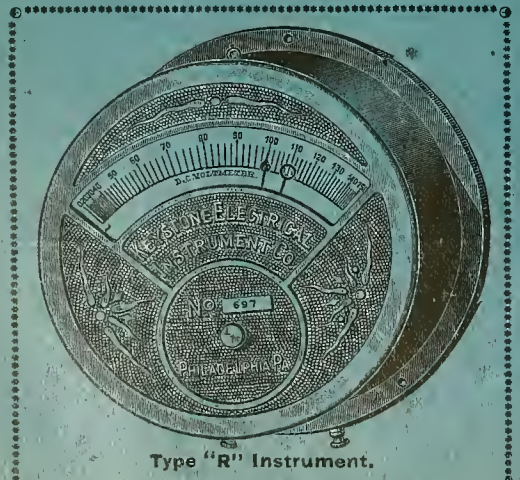

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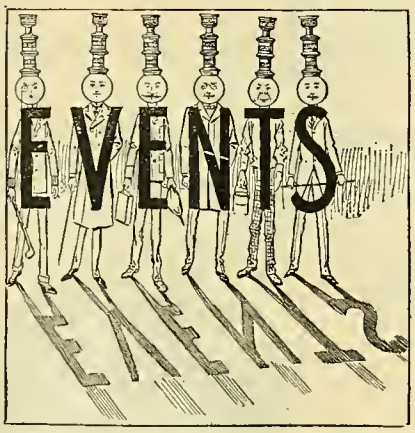

"Coming Events Cast their Shadows Before."

The new "Pioneer" Enclosed Arc Lamp, STYLE "B is an *event* in the electrical world. Its *coming* cast a shadow on cheap competition. It is rich and elegant in exterior, and carefully constructed and tested.

It presents the acme of enclosed arc lighting.

PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — 150 HOURS

THE ELECTRIC ARC LIGHT CO.

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A PERFECT CLUTCH.

No chance for the rods to jam. No parts to be continually renewed. Has a finer adjustment than any other clutch and consequently a saving of current is the result. Can be applied to Brush as well as T.-H. lamps. We also manufacture

Commutators, Segments, Blocks, Brush Arc Cut-Outs and all Arc Lighting Supplies.

SATISFACTORY GOODS AT SATISFACTORY PRICES.

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SOME PEOPLE KNOW A GOOD THING.

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DEAR SIR:—The Wirt Dynamo Brushes which you furnished for our Edison Dynamo, four years ago, have been in use seven days a week and about fifteen hours per day ever since. The brushes are still good for some time to come and the wear on the commutator is imperceptible.

(Signed) JOHN WEYKER, Chief Engineer.

J. B. McKeague, Gen'l Western Agt., 369 Wabash Ave., Chicago. Write for Circular.

Charles Wirt, Patentee and Sole Maker, 1028 Filbert St., Philadelphia.

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INFORMATION, CAUTION AND NOTICE.

The courts of last resort in patent causes have repeatedly and recently sustained **BRUSH PATENTS FOR STORAGE BATTERIES, Nos. 266,090 and 337,299, dated October 17, 1882, and March 2, 1886, covering broadly every practical type of storage battery plate, including not only pasted plates, but also the so-called Plante plates, in the words of JUDGE SHIPMAN** (52d Fed. 130): **"A secondary battery plate ribbed, honeycombed, studded or equivalently prepared . . . . in which the Plante process of electrical disintegration or some kindred process of forming was used."**

In the interest of the development of the storage battery business these fundamental or basic patents have been acquired at great expense by the **ELECTRIC STORAGE BATTERY COMPANY**, and users, vendors and makers of storage batteries and storage battery plates are cautioned against their infringement.

To guard users, vendors and purchasers against inadvertent and unadvised infringement, notice is hereby given that the types of batteries and plates advertised by the following:

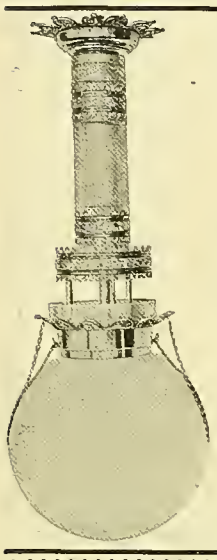
The Electro-Chemical Storage Battery Company.
The Willard Electric & Battery Company,
The Ohio Storage Battery Company,
Norwalk Electric & Battery Company,
The Warwick Electric Manufacturing Company,
Electric Novelty Works,
Momence Electric Ball Storage Battery Co.,
Silvey Storage Battery Co. (Dayton Mfg. Co.),
New York Accumulator & Electric Co.,
The Haschke Storage Battery Company,
Woodward Electrical Company,
Devere Electric Company,
D. J. Hauss,
Eclipse Electric Company,
The American Battery Company,
Samuels Dynamic Accumulator Company,
National Electric Car Lighting Company,

Are considered flagrant infringements; and further, that vendors, purchasers and users thereof will be prosecuted by injunction and otherwise according to law.

THE ELECTRIC STORAGE BATTERY CO.,

Drexel Building, PHILADELPHIA, PA.

BRANCH OFFICES:
66 Broadway, NEW YORK. 1543 Marquette Bldg., CHICAGO. 215 N. Calvert St., BALTIMORE, Md. 222 Market St., SAN FRANCISCO, Cal. 92 State St., BOSTON, Mass.



Upton Long Burning ARC LAMP.

FOR DIRECT CURRENT LOW POTENTIAL CIRCUITS.

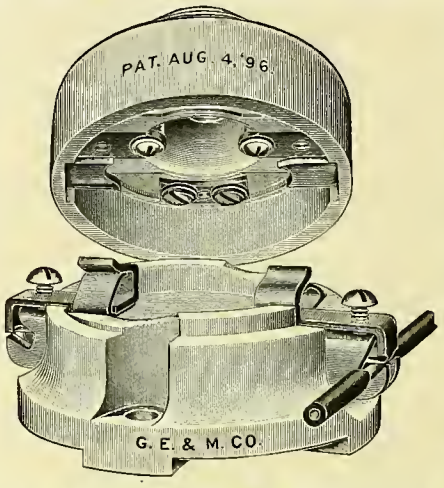
No Mechanism; No Parts to Gum or Wear. No Shadow. No Carbon or Guide Rods to Clean and Polish. Absolutely Steady White Light. Burns 150 Hours on 4½ Amperes without Trimming. Cheaper than any Long Burning Lamp on the Market.

We manufacture Arc Lamps for all circuits. Write us before placing your orders.

STANDARD
THERMOMETER & ELECTRIC CO.,
PEABODY, MASS.

BRANCH OFFICES:
ELECTRIC APPLIANCE CO., 242 Madison Street, Chicago, Ill.
F. L. HAVILAND, 253 Broadway, New York.
STANDARD THERMOMETER & ELECTRIC CO., John Hancock Building, Boston, Mass.

WRITE FOR CATALOGUE E, 31.



'96 LEADS.

WHY?

BECAUSE:

1st—Has perfect contact without marring softest wire.
2nd—Line wire is held by clamp instead of screw points.
3rd—It is easy to take apart; no screw driver, only a quarter turn.
4th—Can use long fuse.
5th—All that use them say so.

Write for Prices on Fuse Blocks, Etc.

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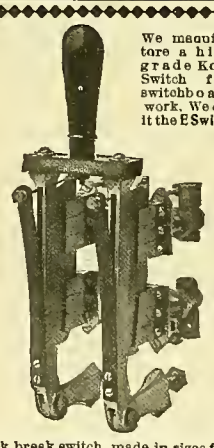

We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.

A quick break switch, made in sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

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WAITING FOR YOUR ORDERS

Sockets, Switches, Cut-Outs,
Tubes and Insulators,
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Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

Western Electric Company.
Chicago. New York.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.

Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

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MANUFACTURERS OF

Standard Systems for Electric Light and Power Distribution in Cities, Factories, Mills and Mines.

The Tesla Polyphase Alternating System of Electrical Transmission by which Power, Incandescent and Arc Lighting may be operated from the same circuits.

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PHILADELPHIA, Girard Building.
PITTSBURG, Westinghouse Building.
ST. LOUIS, American Central Bldg.
SAN FRANCISCO, Mills Building.
SYRACUSE, N. Y., Bastable Building.
TACOMA, WASH., 102 S. 10th Street.
Westinghouse Elec. Co., Ltd. { 32 Victoria St., London, S. W., Eng. / 32 Ave. de l'Opera, Paris, France.

For Canada address Ahearn & Soper, Ottawa, Ont.

PURITAN

IMMEDIATE SHIPMENTS CAN BE MADE.

ALTERNATING ENCLOSED ARC LAMP.

EASY TO TRIM.

WRITE FOR PARTICULARS.

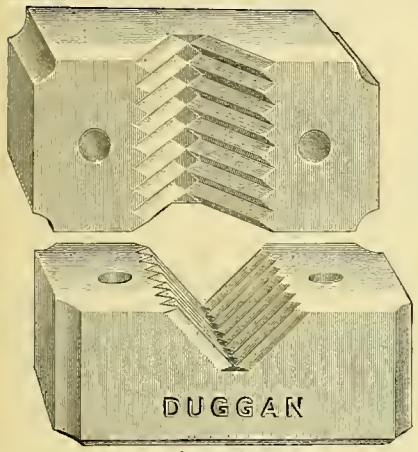
SHORT AND ORNAMENTAL.

BURNS 100 HOURS.

NOISELESS.

150 Nassau Street, NEW YORK. **PURITAN ELECTRIC CO.,** 35 Federal Street, BOSTON, MASS.

THE DUGGAN CLEAT LEADS THEM ALL.



Patented November 14, 1893.

When ordering see that you get the DUGGAN.

Made in one wire No. 4, 5 and 6.
Two wire No. 2 and 3.
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They are corrugated and V-shaped groove.

They grip like a vise.

No sagging wire when once stretched.

They are made of the finest glazed porcelain. Ten of them used to one of any other make.

No. 1, 3 and 4 holds wire 16 to 8.
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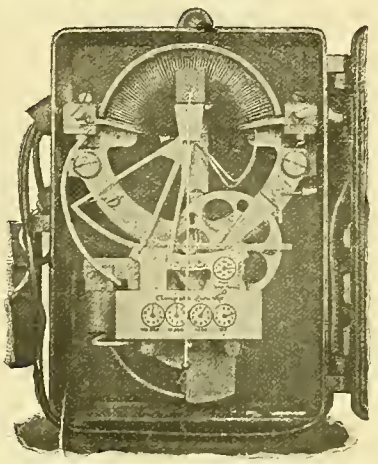
FACTORY, TRENTON, N. J.
Porcelain Specialties of all kinds.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

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LONG-DISTANCE FACTS.

TRANSMISSION OF POWER.

Some of the Three-Phase Long Distance Power Transmissions of the General Electric Company.

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Redlands, Cal.....	Water.	1,170	10,000	21 miles.	Sonora, Cal.....	Water.	1,466	10,000	8 miles.
Portland, Ore	"	4,600	6,000	14 miles.	Trenton, Can.....	"	823	11,000	12 miles.
Sacramento, Cal.....	"	10,982	11,000	22½ miles.	Bakersfield, Cal.....	"	3,420	10,000	16 miles.
Lowell, Mass	Steam.	1,965	5,500	15 miles.	Lachine Rapids, Can ..	"	12,000	4,400	9 miles.
Fresno, Cal.....	Water.	2,275	11,000	35 miles.	Ogden, Utah.....	"	11,050	15,000 / 25,000	40 miles.
Salt Lake City, Utah ..	"	6,800	10,000	13 miles.	Hookset, N. H.....	"	3,000	10,000	10 miles.
Pelzer, N. C.....	"	7,610	3,300	3½ miles.	Minneapolis, Minn....	"	12,000	6,000	8 miles.

In addition to the above the General Electric Co. has installed multiphase power apparatus aggregating over 125,000 horse power.

The Power of NIAGARA FALLS is Transmitted by the General Electric Company's Three-Phase System and Apparatus.

General Electric Company.

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Sales Offices in all Large Cities of the United States. For Canada, address Canadian General Electric Co., Toronto, Can.

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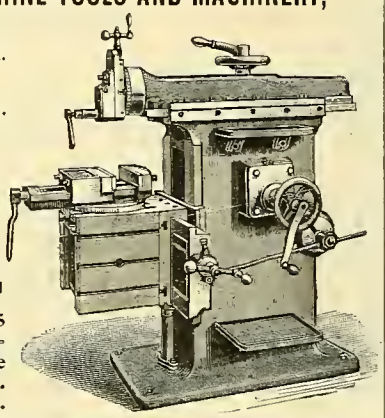
MANUFACTURERS OF MACHINE TOOLS AND MACHINERY,

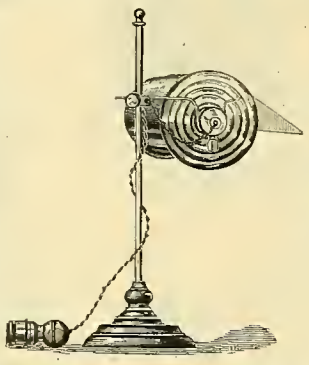
SPRING & VARICK STS., NEW YORK.
51 N. SEVENTH ST., PHILADELPHIA.

WESTERN AGENCY:
Fay & Egan Co., 22 S. Canal St., Chicago.



METAL WORKING MACHINERY.

Our facilities for equipping PLANTS engaged in the manufacture of ELECTRICAL goods are unquestionably the best of any concern in the country. We have in stock over 500 machines. Write us for No. 18 list of new and second-hand machinery. It may be of value to you.



No. 3.—With sliding standard. Can be adjusted to different heights like a Student Lamp. Jewelers, watchmakers, opticians, and others who use the light close to their work find this lamp fills every requirement.

SENSIBLE SHADE LAMPS.

We Make The most sensible Shade Lamps in the world for Physicians, Students, Dentists and all classes of business men. Our lamps are manufactured in ten different styles to suit all kinds of work. Write to us for catalogue and price list. Agents wanted in every city. When you write please mention this paper.

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Agent for Chicago and Cook County.

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Ft. Wayne Elec. Corporation.
Hodge, Walsh & Loring.

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Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
Card Electric Co.
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Metropolitan Electric Co.
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Washburn & Moen Mfg. Co.
Western Electric Co.

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Samson Cordage Wks.

Crookes' Tubes.
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Perkins Elec. Switch Mfg. Co.

Cross-Arms, Pins and Brackets.
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Electric Appliance Co.
Farr Tel. & Const. Supply Co.

Cut-Outs and Switches.
Automatic Cir. Breaker Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Clymer & Heilman.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Farr Tel. & Const. Supply Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
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Hart & Hegeman Mfg. Co.
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Morrison Southern El. Co.
Pacific Electric Co.
Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Phila. El. & Mfg. Co.
Reynolds, S. K.
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Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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General Electric Co.
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Hine & Co., L. A.
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Pacific Electric Co.
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Peru Elec. Mfg. Co.
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Bogart, A. L.

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Huebel & Manger.
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Northwest Engineering Co.
Ohio Electric Works.
Pacific Electric Co.
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India. Rub. & Ins. Wire Co.
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Garvin Machine Co., The.
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Eddy Elec. Mfg. Co.
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Hine & Co., L. A.
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Platinum.
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Lindsley Bros.
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Tagatz, H. A.

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Peru Elec. Mfg. Co.

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Rockwood Mfg. Co., The.

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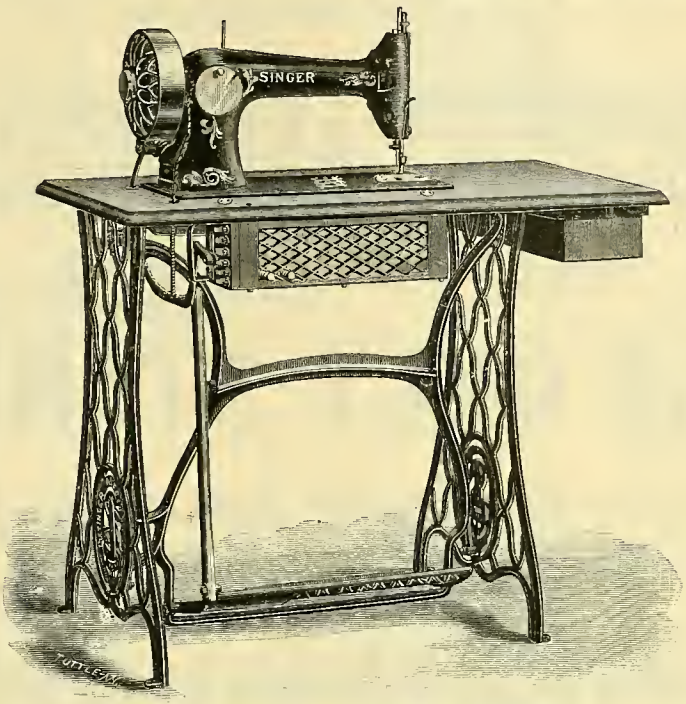
THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

MOTORS are entirely **SELF-CONTAINED** and replace the ordinary balance wheels.

THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



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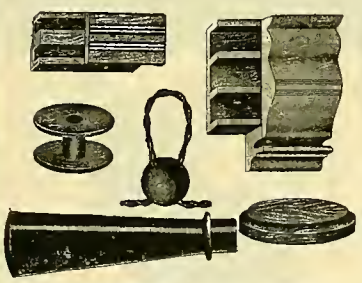

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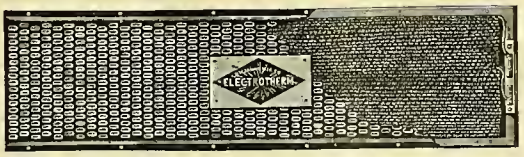

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No coils to short-circuit or break, no oxidation, perfect air circulation, easily controlled and regulated by patented knife switch. Adjustable to three different degrees of heat. Prices, etc., on application. . . . . .

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We Offer the Only Complete System of Electric Wiring.

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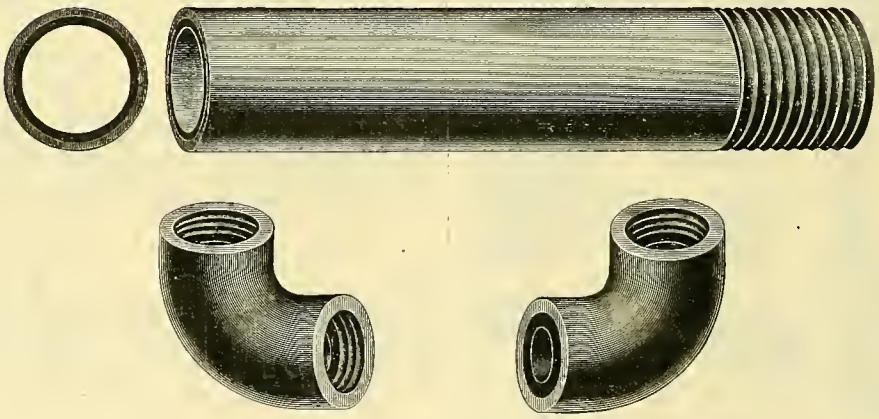
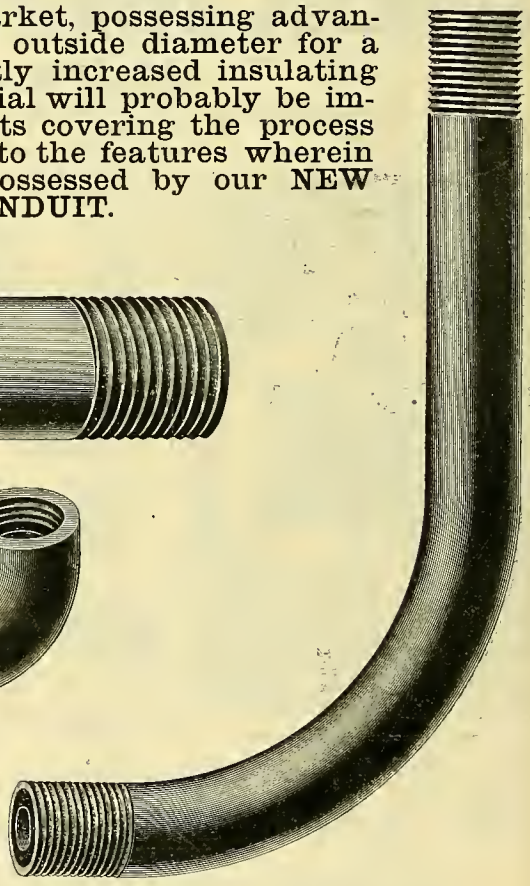
Is far superior to any ever placed upon the market, possessing advantages in that it is extremely light, has a smaller outside diameter for a given inside diameter, and moreover, has greatly increased insulating properties. Like all other standards, this material will probably be imitated. However, the broad, fundamental patents covering the process of manufacture prevent even a near approach to the features wherein lie the strength and integrity of insulation possessed by our NEW STANDARD IRON ARMORED INSULATING CONDUIT.





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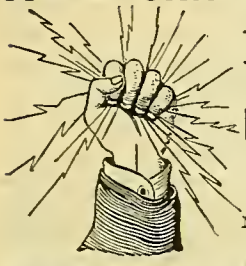

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HIGH INSULATION.

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"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

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FOR SWITCHBOARD, RAILWAY and MOTOR USE.

All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
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The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

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$3,000 will buy two-thirds stock issued in telephone company doing prosperous business in live western town. Address **"Telephone,"** care WESTERN ELECTRICIAN, Suite 510 Marquette Building, Chicago.

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Four Electrical Generators in First-class Condition.

Constant potential, 150 K. W., Type A 23-7 Volts, 500; amperes, 300. Detroit Electrical Works' Standard. Apply to

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A position to take charge of an electric light plant. Good, all round man. Understand water-works pumps. Am a married man and will do good work for reasonable wages. Address "ELECTRICIAN," 509 27th Street, Milwaukee, Wis.

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ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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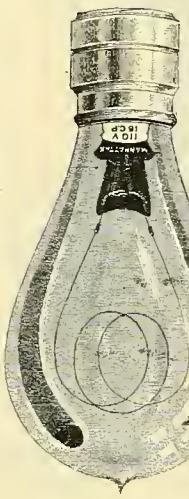

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Has no superior. It is not a combine lamp and is on the market at the lowest price a high-grade lamp can be sold for.

Efficiency, life and maintainence, candle power unrivaled.

All prices, delivered, we pay the freight.

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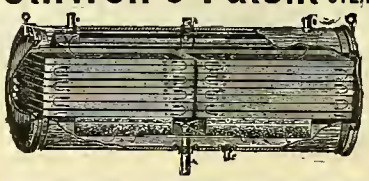

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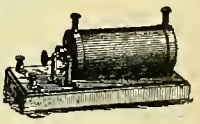

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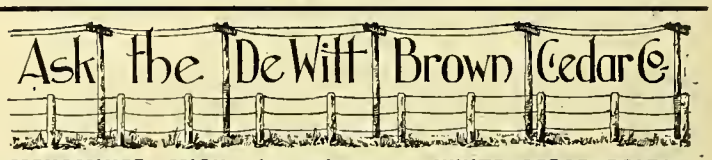

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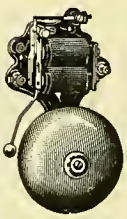

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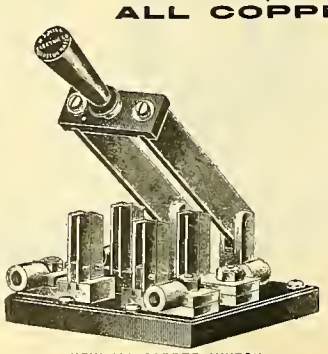

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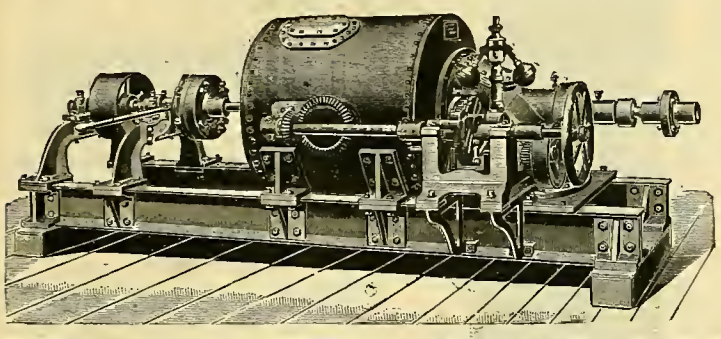

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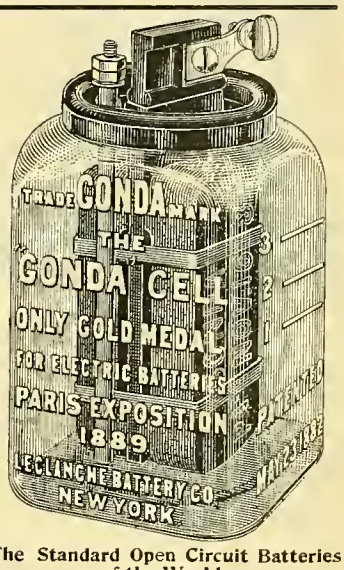

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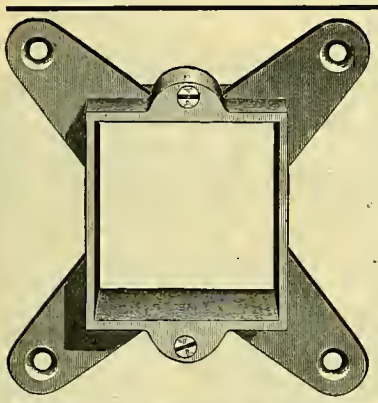

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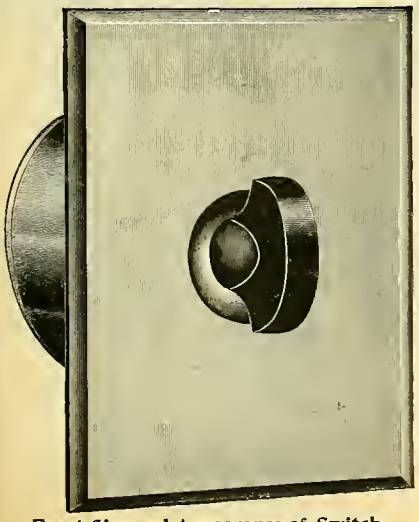

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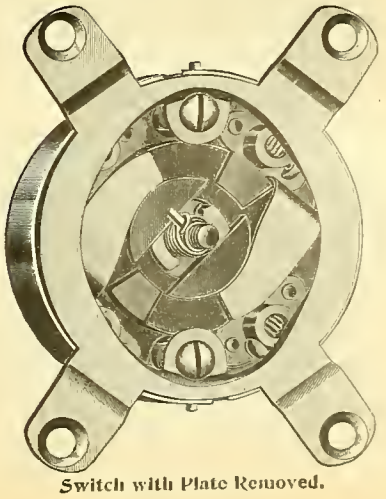

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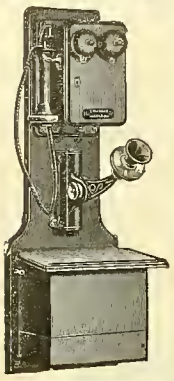

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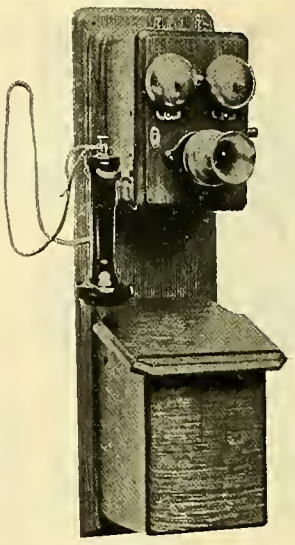

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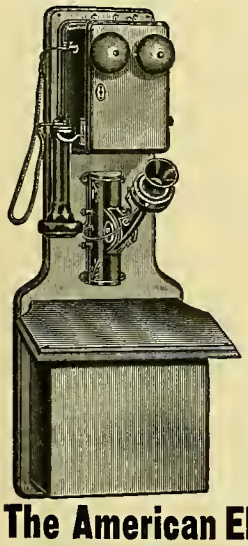

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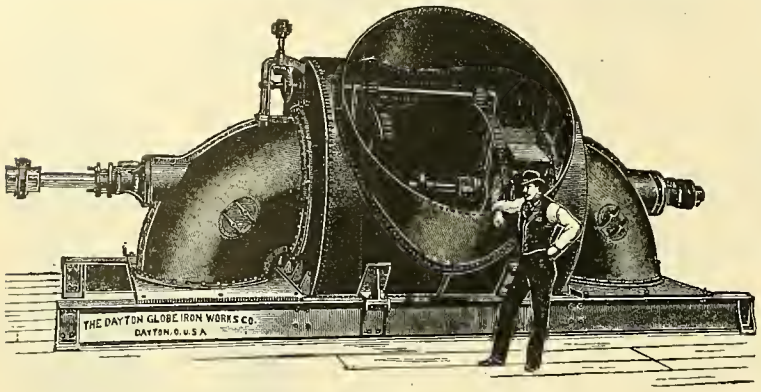

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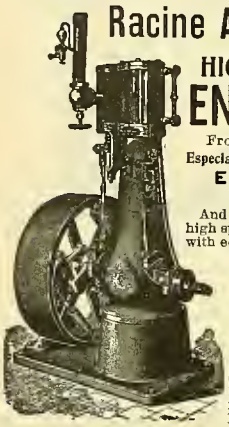

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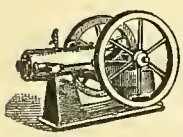

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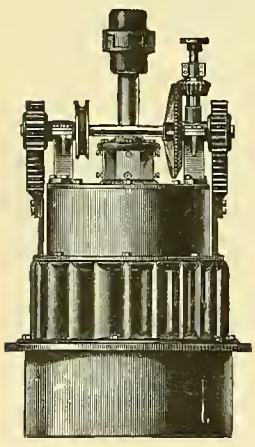

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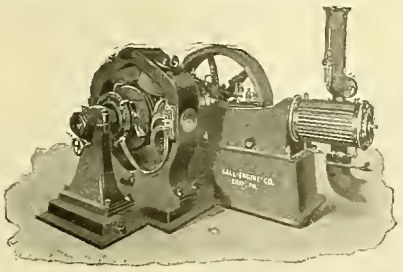

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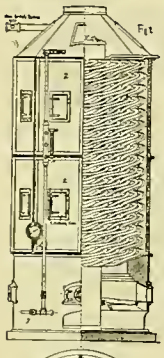

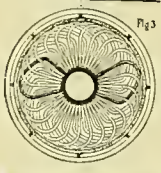

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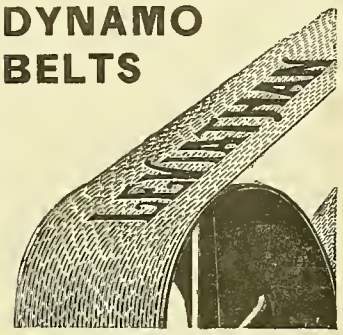

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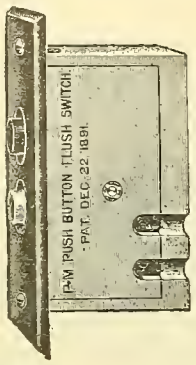

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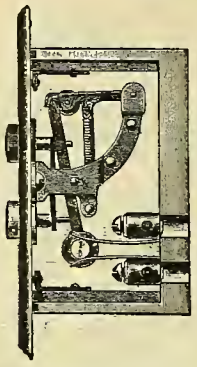

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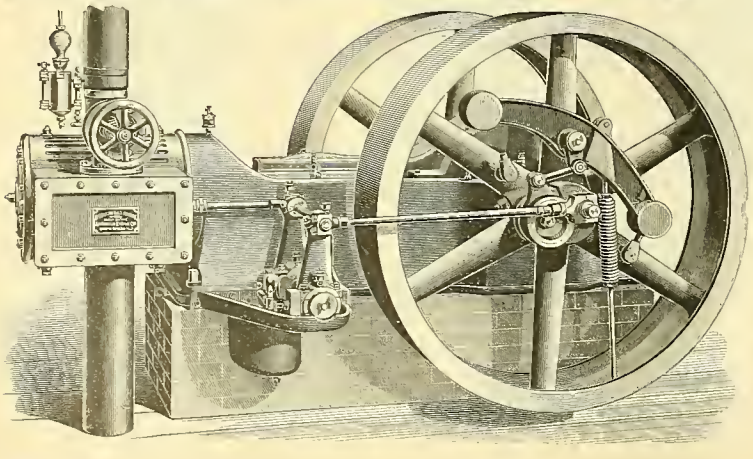

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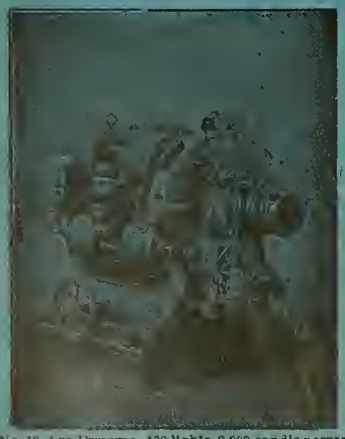
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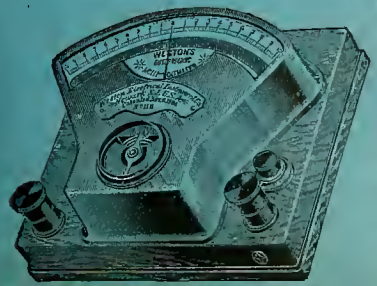

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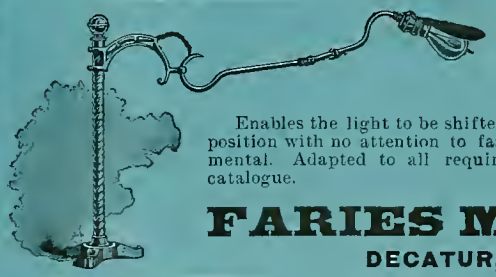

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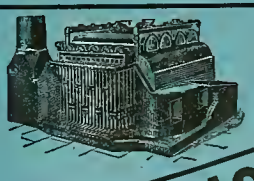

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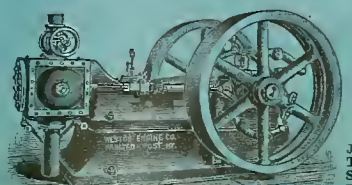

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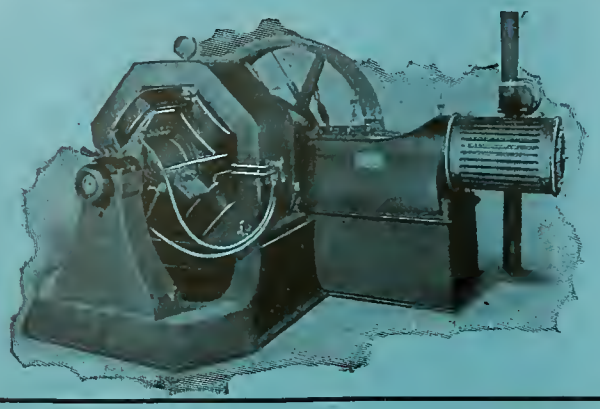

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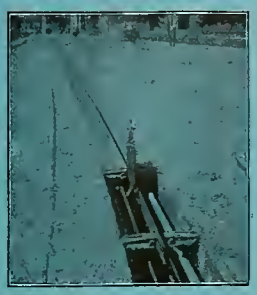

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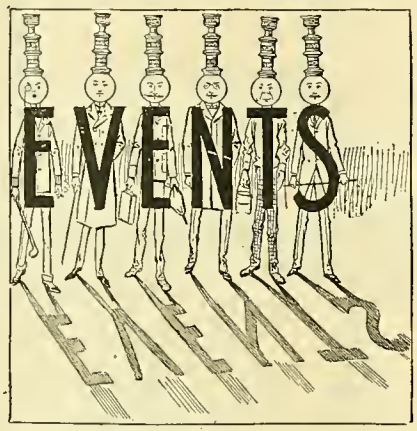

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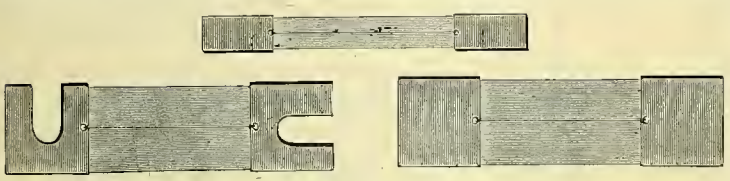

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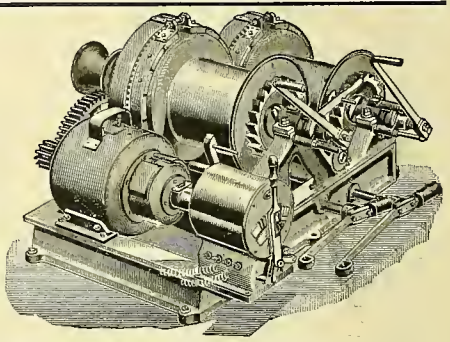

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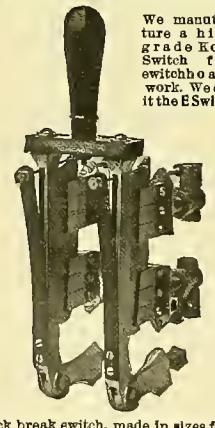

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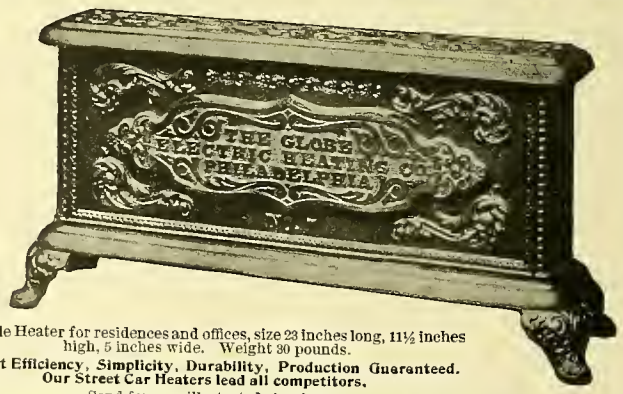

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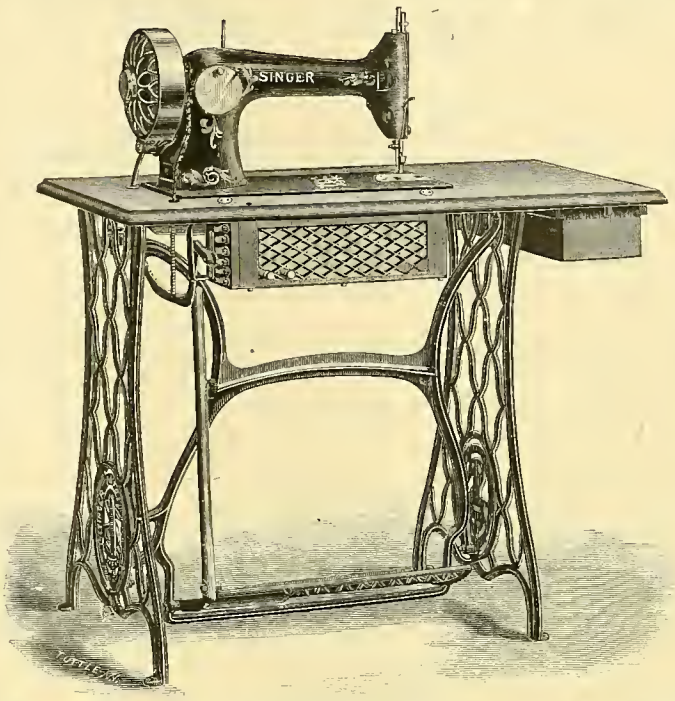

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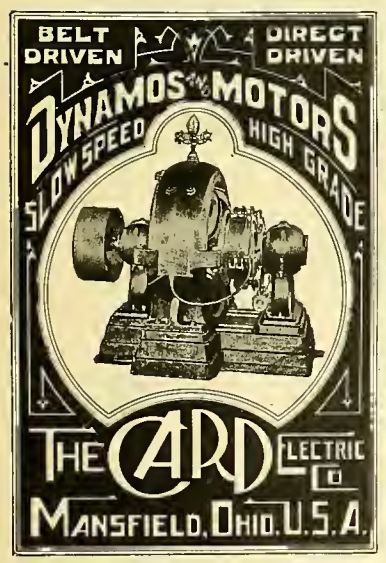

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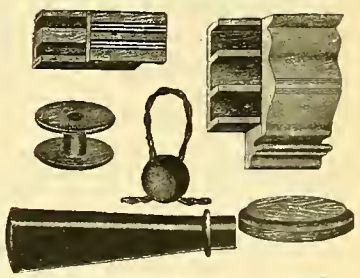

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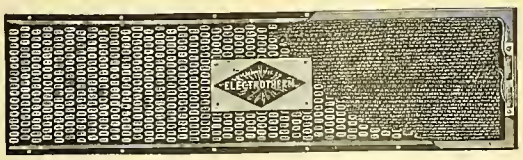

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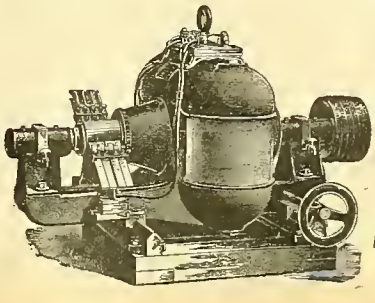

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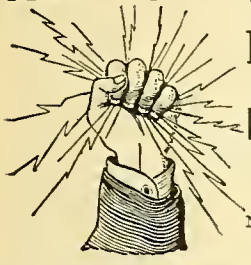

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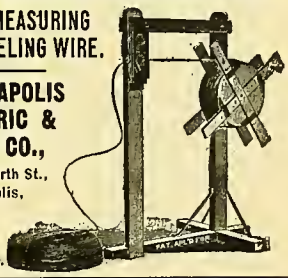

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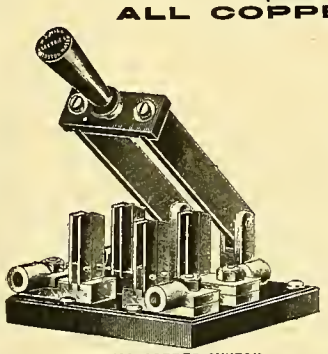

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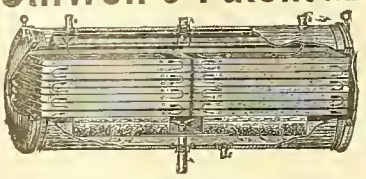

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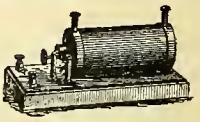

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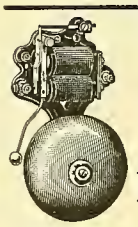

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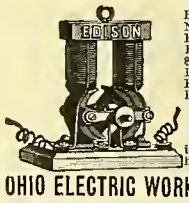

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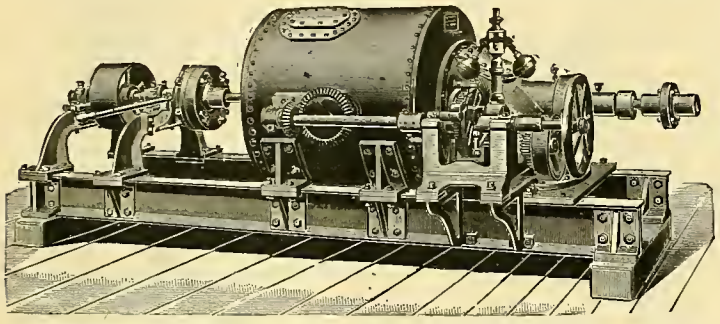

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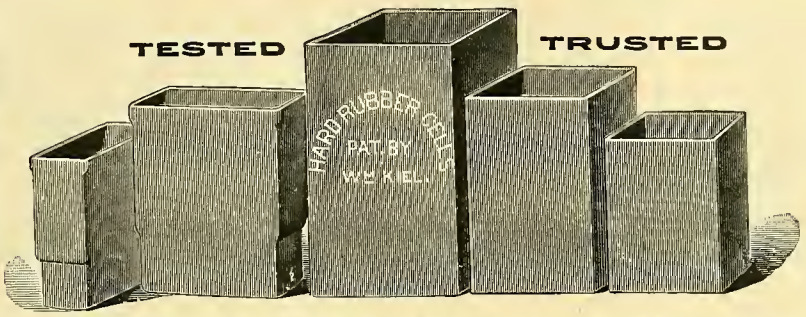

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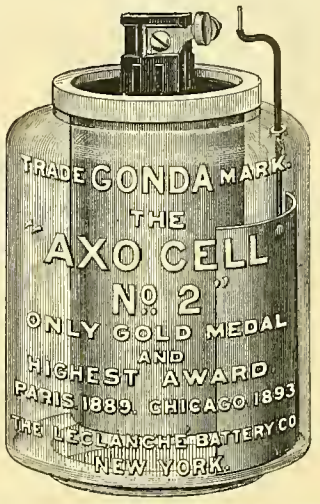

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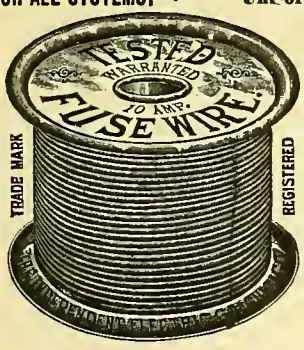

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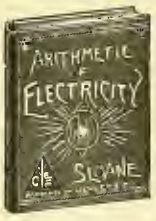

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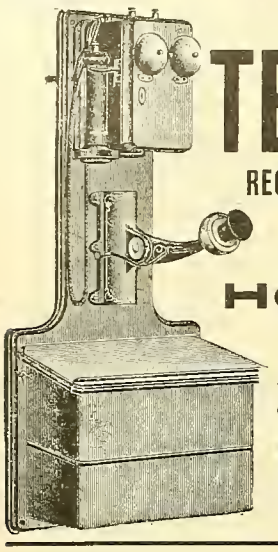

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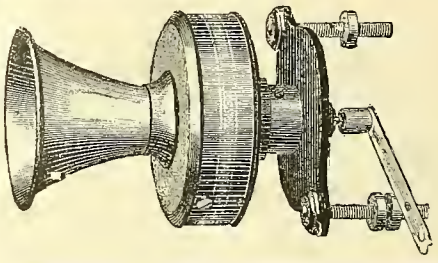

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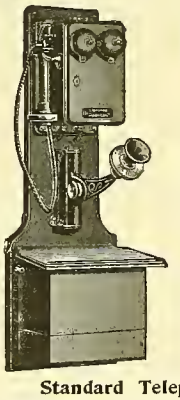

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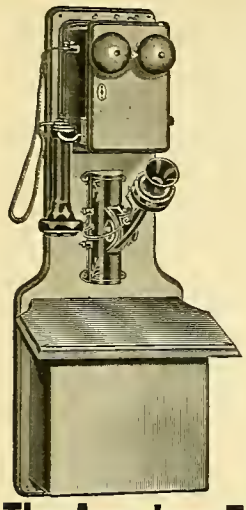

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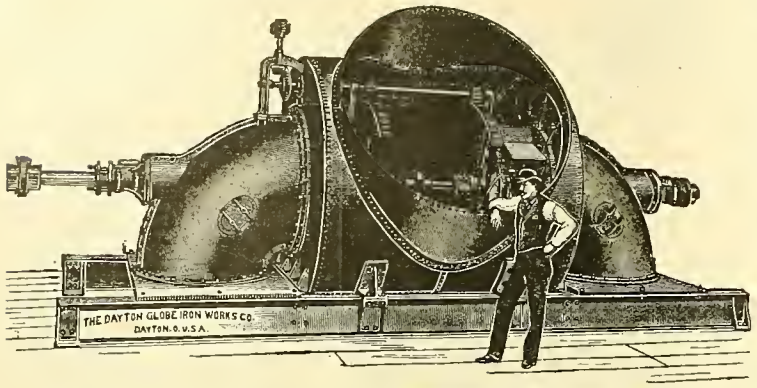

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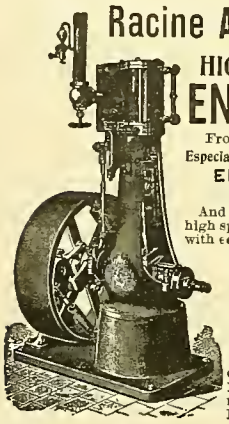

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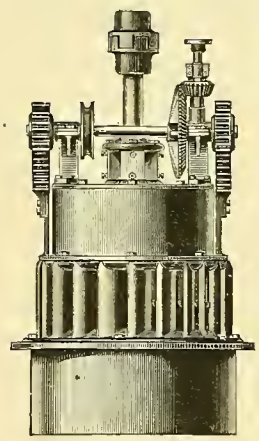

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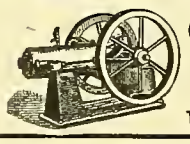

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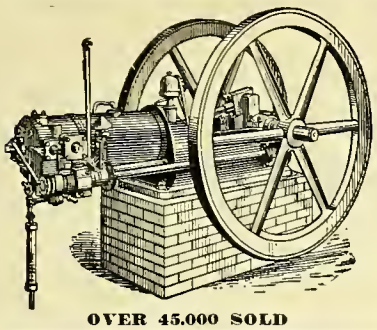

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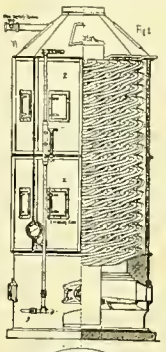

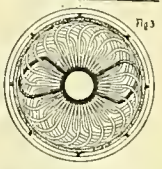

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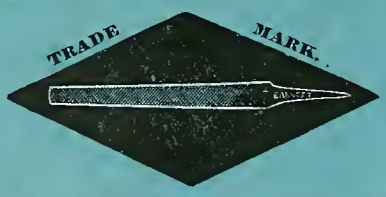

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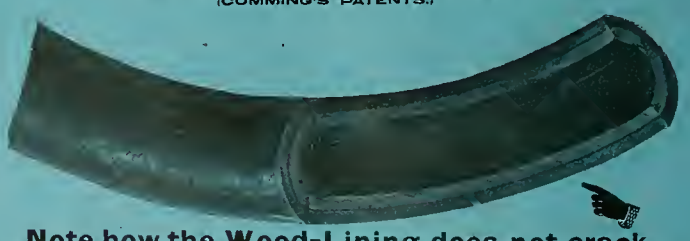
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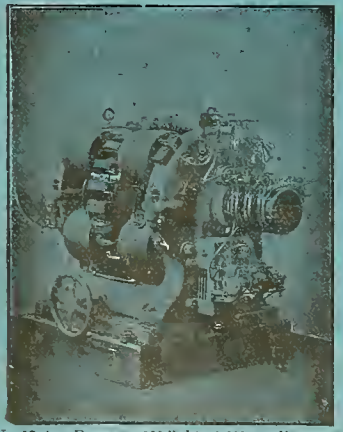
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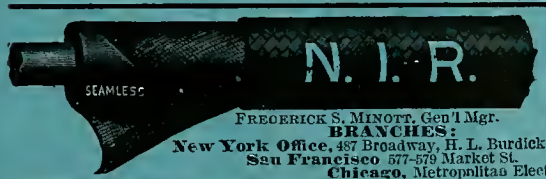

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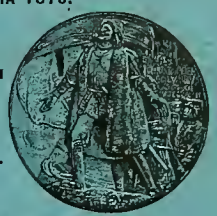

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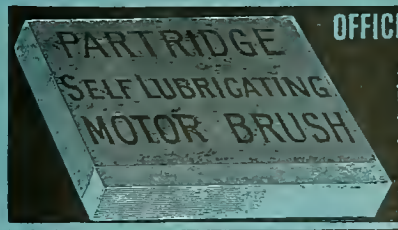

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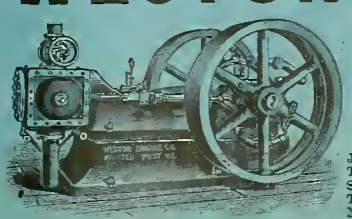
Smith & Wallace, Hamilton St., Boston, Mass.
Ed. P. Sharp, 44 Niagara St., Buffalo, N. Y.
Arthur S. Partridge, Bank of Commerce Bldg., St. Louis, Mo.
J. M. Atkinson & Co., 1430 Monadnock Bldg., Chicago, Ill.
Reger & Atwater, 314 Pine St., San Francisco, Cal.
Central Electric Co., 173 Adams St., Chicago.
Harry N. Shaw, 120 Liberty St., New York.

WESTON ENGINES.



High Pressure Boilers.
Complete Power Plants.

Estimates and Drawings Submitted.

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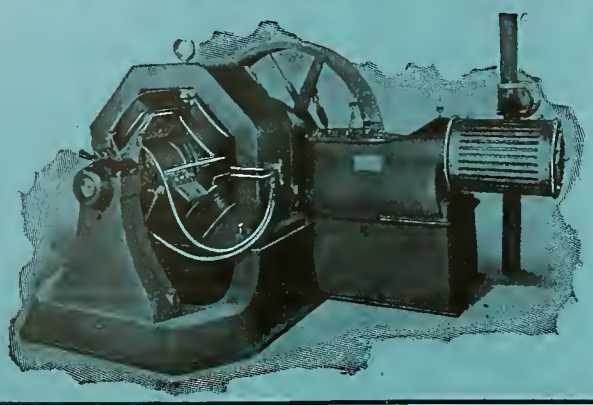
THE REYNOLDS-LABOR & CO., 41 No. 7th St., Phila.
SCRANTON SUPPLY & MACH'Y CO., - Scranton, Pa.
THOS. K CAREY & BROS. CO., 26 Light St., Baltimore, Md.
MITCHELL, LEWIS & STAVER CO., Seattle Wash.

EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.

THE K. A. K. CONDUIT SYSTEM.

Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.

Practical in Operation.

SEND FOR FULL PARTICULARS.

KROTZ, ALLEN & KELLY, SPRINGFIELD, OHIO.

READ THE BLUE ELECTRICAL PAPER.

Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.
COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated braod of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

SAMPLE UPON APPLICATION. **C. P. WILLIAMS,** Sole Agent U. S. A. 39-41 Cortlandt St., New York City.

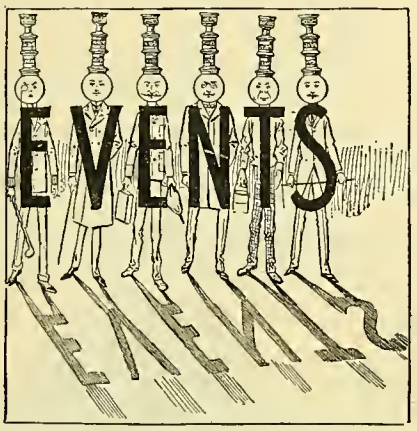
KEYSTONE ELECTRICAL INSTRUMENT COMPANY.

Galvanometer Ground Detector.

Switchboard Voltmeters, Ammeters, Ground Detectors and Differential Voltmeters.

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating current circuits.
Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.
We can interest you in prices and other details if you will write to

Ninth St. and Montgomery Ave., Philadelphia.
New York, 36 Dey Street.
Chicago, 1440 Monadnock Building.



"Coming Events Cast their Shadows Before."

The new "Pioneer" Enclosed Arc Lamp, STYLE "B is an *event* in the electrical world. Its *coming* cast a shadow on cheap competition. It is rich and elegant in exterior, and carefully constructed and tested.

It presents the acme of enclosed arc lighting.

PIONEERS IN ENCLOSED ARC LIGHTING — 150 HOURS

THE ELECTRIC ARC LIGHT CO.

LOUIS B. MARKS, M.M.E., CHIEF ELECTRICIAN, 687 & 689 Broadway, NEW YORK.

SOME PEOPLE KNOW A GOOD THING.

KINSLEY'S RESTAURANT, CHICAGO, ILL., Jan. 26, 1897.

MR. CHAS. WIRT, Philadelphia.

DEAR SIR:—The Wirt Dynamo Brushes which you furnished for our Edison Dynamo, four years ago, have been in use seven days a week and about fifteen hours per day ever since. The brushes are still good for some time to come and the wear on the commutator is imperceptible.

(Signed) JOHN WEYKER, Chief Engineer.

J. S. McKeague, Gen'l Western Agt., 369 Wabash Ave., Chicago. Write for Circular.

Charles Wirt, Patentee and Sole Maker. 1028 Filbert St., Philadelphia.

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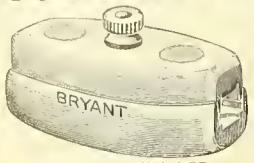
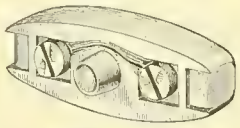
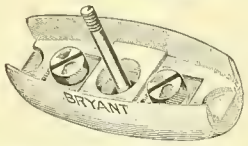


COVERED—ACTUAL SIZE.





OPEN—ACTUAL SIZE. No. 1106.

No. 1106 BRYANT BUG COVERED CUT-OUT.

ONE NUT ONLY.

IMPOSSIBLE TO SHORT CIRCUIT.

FUSE IN CAP NOT IN BASE . . . . .

Not necessary to disturb CONNECTING WIRES in replacing FUSE. Write your supply house for samples and price. If they cannot furnish, write us direct.

BRYANT ELECTRIC CO.,

BRIDGEPORT, CONN. CHICAGO, ILL.

THE UPTON LOW TENSION ARC LAMPS.

To burn two in series on 110 volts, from 4 to 10 amperes, as desired.

The lamps are positive in their action, requiring only the amperage on which they are designed to burn. Give a steady, even, white light.

Are equally adapted for inverted arc service for mill work or where a reflected light is desirable.

We also manufacture the simplest **long burning lamp** on the market for low potential circuits. **Also lamps for all circuits.**

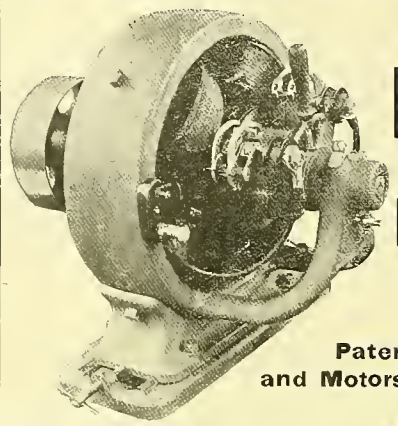
Standard Thermometer AND Electric Co.,

PEABODY, MASS.

Branch Offices | Electric Appliance Co., 242 Madison St., Chicago, Ill.
F. L. Haviland, 253 Broadway, New York.
Standard Thermometer & Electric Co., John Hancock Building, Boston, Mass.

WRITE FOR CAT. E. 31.

WRITE FOR INFORMATION.



DYNAMOS,

15 to 1,000 Lights.

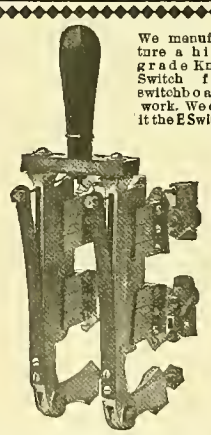
MOTORS,

½ to 50 H. P.

ANY VOLTAGE.

Patented adjustable Dynamos and Motors for floor, wall or ceiling.

The Ahlm-Edwards Electric Co., MEDINA, OHIO.



We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.

A quick break switch, made in sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

We have in stock in our Chicago Store

WAITING FOR YOUR ORDERS

Sockets, Switches, Cut-Outs,
Tubes and Insulators,
Shawmut Fuse Wire and Knife Switches,
Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

Western Electric Company.

Chicago. New York.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.

Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

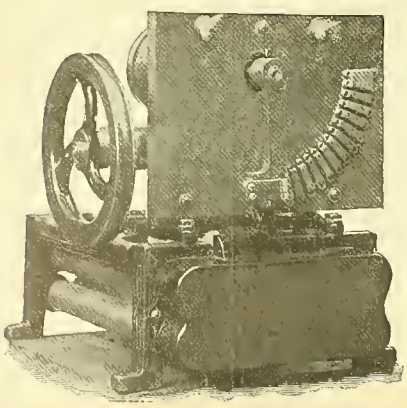
Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

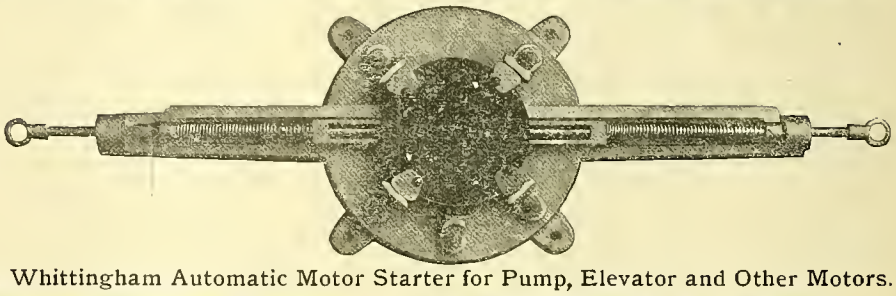
Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.

NEW AND GOOD.



Quick Acting Switch for Pump, Elevator and Other Motors.



Latest Type Whittingham Automatic Motor Starter for Pump, Elevator and Other Motors.

Strong, Reliable, Efficient. THEY PREVENT ACCIDENTS AND SAVE MONEY. Write for Catalogue and Prices.

AUTOMATIC SWITCH COMPANY, 703 Equitable Building, BALTIMORE, MD.

IN THE "AD." STUDIO

——OF THE——

COMMERCIAL ELECTRICAL SUPPLY CO.,

ST. LOUIS.

(Subject—Diehl Arc Lamps—and "Others.")

Flag 'em, Willie!
—Switch 'er off!
—I'm sick of holding this sleepy kid.

A LONG LETTER.

(Please oblige us by **not** reading this—it cost a good deal of money—but still—)

This caught your eye? Of course it did! We advertise this way because it attracts attention. We say but little about our goods in the ad.—not because there's nothing to say but because we want you to **write** so we can post you more fully. You have always dealt with another house? Well, give **us** your order this time. From the fact that you've always moved in one rut you may find us a profitable surprise. We carry a very large assortment—our ads. are but "glimpses"—try us.

Yours,
Commercial Electrical Supply Company.

P. S. The lamps used in this ad. are the new "Diehl" inclosed arcs (that do away with shadows). The carbons are "Electras." The wires to the lamps were sold by "Habirshaw Jim Godfrey" and those to one lamp came up through "Interior Conduit," while those to the other came up through "Circular Loom Conduit." The switchman Willie "flagged" worked a "Wagner." P & B paint made the background, and the "air" on which the owl floats was furnished by one of our traveling men. Last but not least. "Little Willie's" joints were made with "Clifton Tape," and the same man that furnished the "air" hypnotized the kid model.

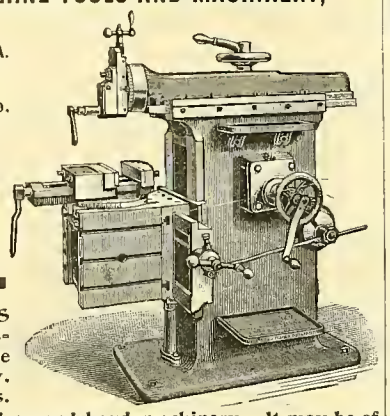
P. S. Try us—it'll pay.

The Garvin Machine Co.,

MANUFACTURERS OF MACHINE TOOLS AND MACHINERY,

SPRING & VARICK STS., NEW YORK.
51 N. SEVENTH ST., PHILADELPHIA.

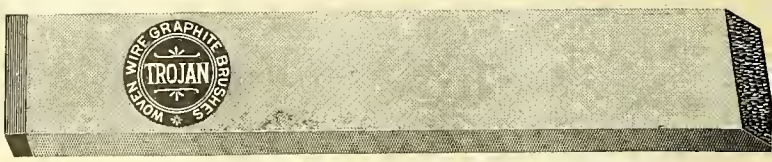
WESTERN AGENCY:
Fay & Egan Co., 22 S. Canal St., Chicago.



METAL WORKING MACHINERY.

Our facilities for equipping PLANTS engaged in the manufacture of ELECTRICAL goods are unquestionably the best of any concern in the country. We have in stock over 500 machines. Write us for No. 18 list of new and second-hand machinery. It may be of value to you.

NEW EDITION,
CROSBY & BELL'S ELECTRIC RAILWAY,
JUST OUT. PRICE $2.50. SEND FOR IT.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO.



EVERY GOOD FEATURE COMBINED.
BEST METAL. BEST MADE.
WE SELL DIRECT TO THE USER. BUY OF THE MANUFACTURER AND SAVE 50 PER CENT.

HOBART ELECTRIC MFG. CO.,
TROY, OHIO.

Steam Engineering and Electricity Taught by Mail.

Our *Stationary Engineers' Scholarship* includes instruction in Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Mechanical Drawing, Steam and Steam Engines, Steam Boilers, Dynamos and Motors.

Besides a thorough education in the theory of Steam Engineering the instruction is designed to qualify Steam Engineers and other students to understand, operate and care for electrical machines; to instill electrical plants; to perform calculations and to locate and remedy faults.

Studies are carried on at home. No time lost from work. Specially prepared Instruction and Question Papers, superior to text-books, furnished free to students.

Also courses in Mechanics; Civil Engineering in all its branches; Book-Keeping and Business Forms and the English Branches.

A circular giving full particulars will be sent free. Mention the subject in which you are interested. Address

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Box 1002, Scranton, Pa.

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Annunciators.
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Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

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Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
Manhattan Gen'l Cons. Co.
Perkins Elec. Switch Mfg. Co.
Puritan Electric Co.
Standard Therm. & Elec. Co.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Samson Cordage Wks.

Assayers.
Nat'l. Ore & Reduction Co.

Batteries and Jars.
Andrae, J. & Sons Co.
Butler Hard Rubber Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Dearborn Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Genor & Colburn.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Midland Electric Co.
Ohio Electric Works.
Peru Elec. Mfg. Co.
Western Electric Co.

Bells.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Jewell Belting Co.
Main Belting Co.
Shultz Belting Co.

Boilers.
Clonbrock Steam Boiler Co.
Racine Hardware Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Brushes.
Commercial El. Supply Co.
Hobart Elec. Mfg. Co.
Holmes Fibre-Graphite Co.
McKeague, J. B.
Partridge Carbon Co.
Wirt, Chas.

Burglar Alarms.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.
Western Electric Co.

Cables (See Insulated Wires.)

Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Brixey, W. R.
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Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points & Plates.
Chicago Edison Co.
Chicago General Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Standard Paint Co.
Western Electric Co.

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Brill Co., J. G.

Coloring for Inc. Lamps.
Webster Chemical Co.

Compound.
California Asphalt Co.
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Electric Appliance Co.
Johns Mfg. Co., H. W.
McLennan & Co., K.
Okonite Co.
Standard Paint Co.

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Armorite Interior Cond. Co.
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Electric Appliance Co.
Interior Conduit & Ins. Co.

Construction & Repairs.
Andrae, J. & Sons Co.
Chicago Edison Co.
Electrical Exchange, The.
Ft. Wayne Elec. Corporation.
Gregory Co., Chas. E.
Hodge, Walsh & Loring.

Contractors and Electric Light Plants.
Ahlm-Edwards El. Co.
Andrae, J. & Sons Co.
Arnold, B. J.
Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
Card Electric Co.
Clymer & Heilman.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
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Northern Electl. Mfg. Co.
Patitz, A. M.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Westinghouse Elec & Mfg Co.
Western Electric Co.

Copper.
Besly & Co., Chas. H.
Mansfield Temp. Copper Co.
McDermid Mfg. Co.

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Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
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Okonite Co., The.
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Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.
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General Electric Co.
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(See Insulated Wires.)

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Garvin Machine Co., The.
Robertson & Sons, J. L.
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Munsell & Co., Eugene.
Rich, Jas. W.

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Eddy Elec. Mfg. Co.
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Hine & Co., L. A.
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Northern Electl. Mfg. Co.
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Lindsley Bros.
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Tagatz, H. A.

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Imperial Porcelain Works.
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Peru Elec. Mfg. Co.

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Electrician Publishing Co.

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Rockwood Mfg. Co., The.

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Electric Appliance Co.
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Swarts Metal Refining Co.

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Hodge, Walsh & Loring.

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Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
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Sal Ammoniac.
Klipstein & Co., A.

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Gregory Co., Chas. E.

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Electric Appliance Co.
Partrick & Carter Co.

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Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

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Webster & Co., Warren.

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Electric Storage Battery Co.

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Faries Mfg. Co
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Metropolitan Electric Co.
Moore, Alfred F.
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Okonite Co., The.
Simplex Electrical Co.
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Washburn & Moen Mfg. Co.

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Electric Appliance Co.
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Stanley Electric Mfg. Co.
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Samson Cordage Wks.

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General Electric Co.
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Dayton Globe Iron Works Co
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Brixey, W. R
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Electric Appliance Co.
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Phillips Insulated Wire Co.
Standard Underground C. Co
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Edison Dec. & M. Lamp Dept
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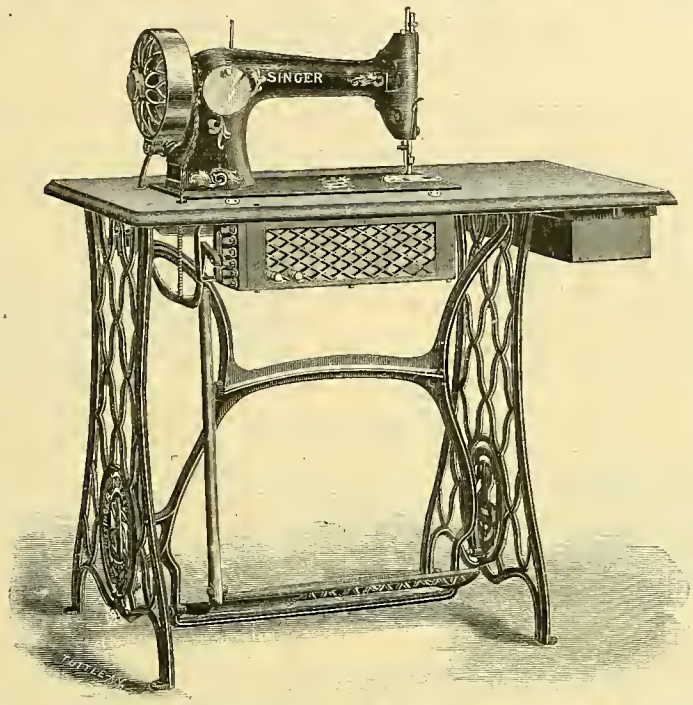
THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

MOTORS are entirely **SELF-CONTAINED** and replace the ordinary balance wheels.

THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



IN THIS MANNER

The highest economy is attained, because all objects intervening between the source and subject of power are dispensed with and the electric current is only used when the machine is running.

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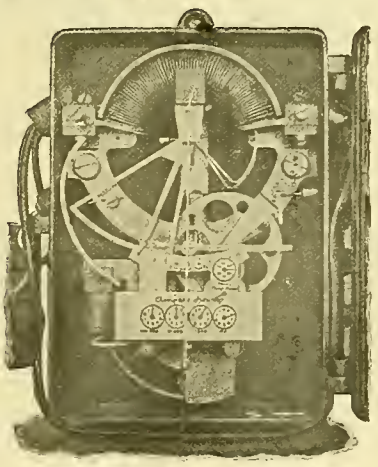
THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



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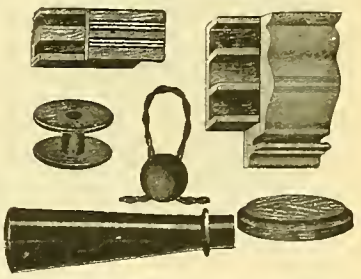
Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 870 LBS.



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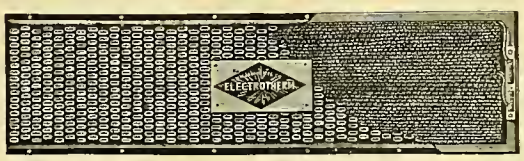

Simplicity—Effectiveness—Durability—Economy.

No coils to short-circuit or break, no oxidation, perfect air circulation, easily controlled and regulated by patented knife switch. Adjustable to three different degrees of heat. Prices, etc., on application. . . . . .

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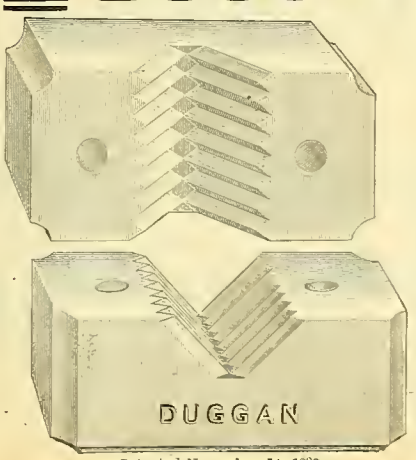
LEADS THEM ALL.



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Made in one wire No. 4, 5 and 6.
Two wire No. 2 and 3.
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They are corrogated and V-shaped groove.

They grip like a vise.

No sagging wire when once stretched.

They are made of the finest glazed porcelain. Ten of them used to one of any other make.

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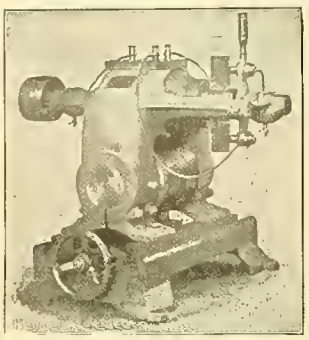
Porcelain Specialties of all kinds.



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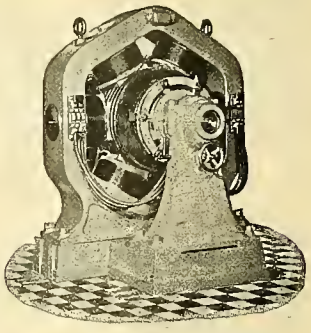

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INTERIOR CONDUIT

(CUMMING'S PATENTS.)

Note how the Wood-Lining does not crack.

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Arc Lamps, Carbons.

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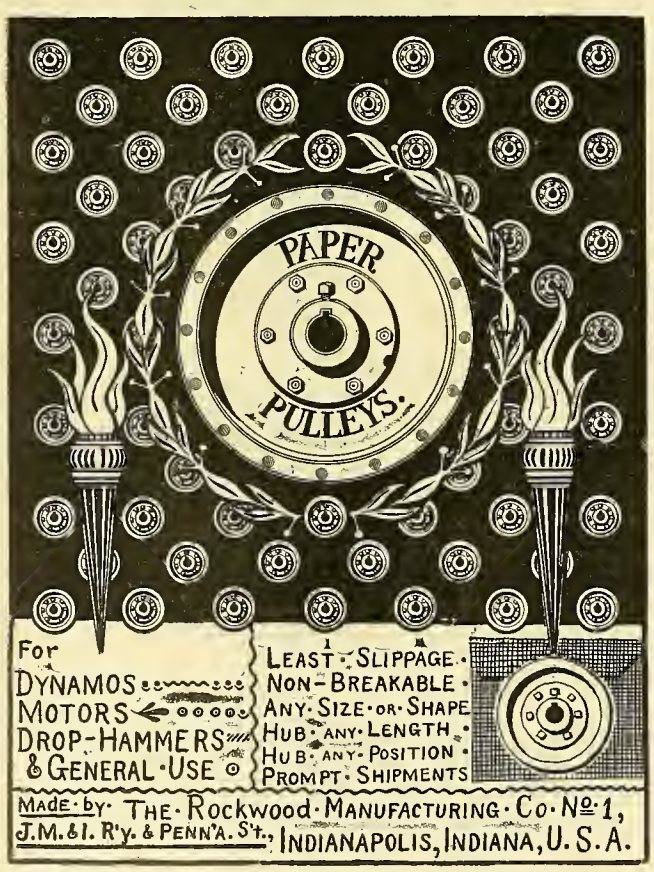

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MANUFACTURE GENERAL ELECTRIC SUPPLIES

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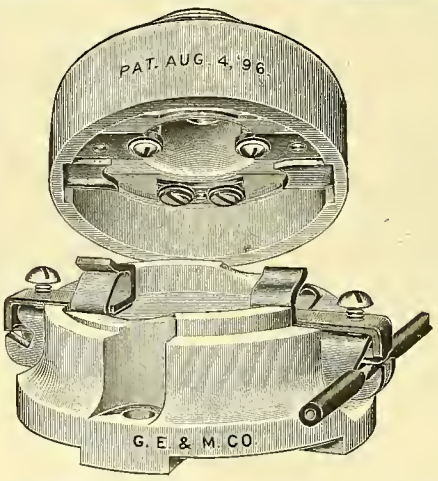
SIGNAL GONGS-BELLS etc.



'96 LEADS.

WHY?

BECAUSE:

1st—Has perfect contact without marring softest wire.

2nd—Line wire is held by clamp instead of screw points.

3rd—It is easy to take apart; no screw driver, only a quarter turn.

4th—Can use long fuse.

5th—All that use them say so.

Write for Prices on Fuse Blocks, Etc.

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BUCKEYE

QUALITY UNEQUALED

FACTORY PRODUCTION TRIPLED.

INCANDESCENT LAMPS.

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THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.

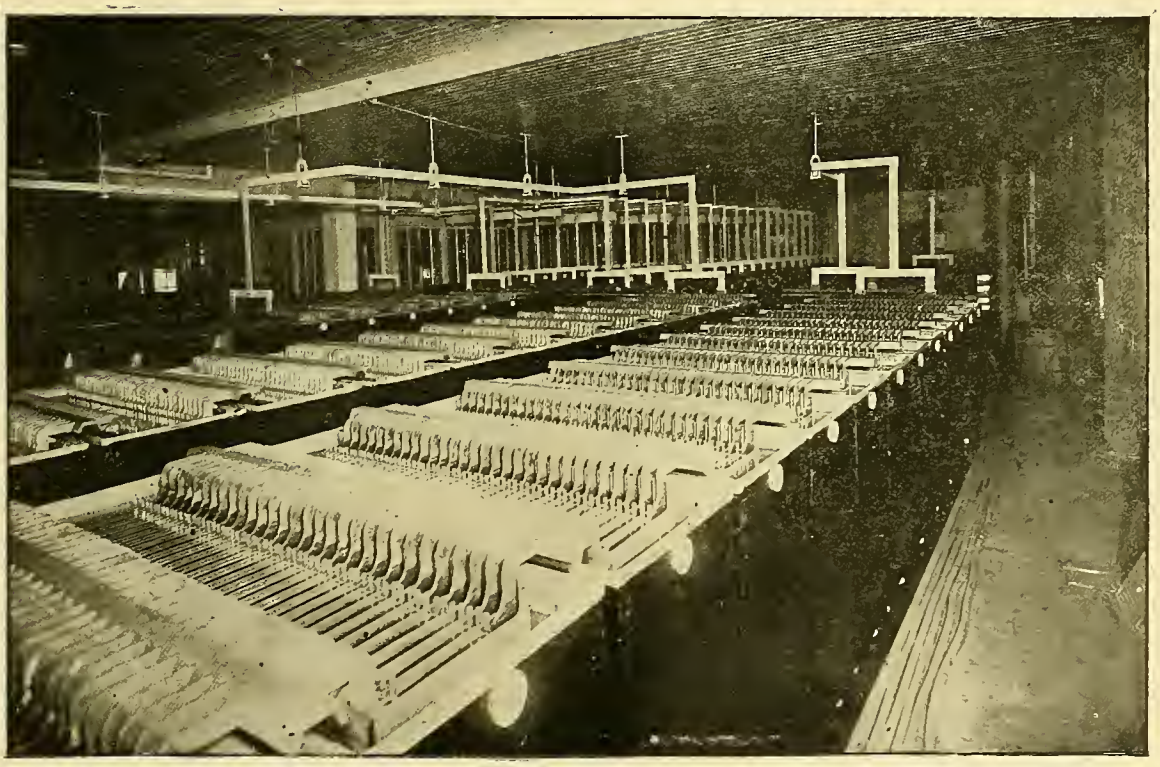
The Largest Storage Cells in the World.

HIGH TENSION TRANSMISSION WITH LOW TENSION DISTRIBUTION

BY MEANS OF

"CHLORIDE ACCUMULATORS."

REGISTERED SEPTEMBER 11, 1894.



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THE ELECTRIC STORAGE BATTERY COMPANY,

DREXEL BUILDING,

PHILADELPHIA.

BRANCH OFFICES:

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LONG DISTANCE TRANSMISSION OF POWER.

The Westinghouse Electric & Manufacturing Company, owning the Tesla patents, and having had all the advantages of the use of such patents, manufactures the best polyphase apparatus for the two-phase system, the three-phase system and the C. F. Scott system, which combines the advantages of both.

The electric power at Niagara Falls is generated by the Westinghouse Electric & Manufacturing Company's Apparatus, and is transmitted by the three-phase system covered by the patents of C. F. Scott and controlled by the Westinghouse Company. The Cataract Construction Company has, (in addition to the three 5,000 h. p. generators already purchased), contracted with the Westinghouse Company for five additional generators, each of 5,000 h. p. capacity. The statement of the General Electric Co. that "the power of Niagara Falls is transmitted by the General Electric Company's three-phase system and apparatus," is intentionally misleading.

Among the plants equipped with our apparatus, in addition to the great plant at Niagara Falls, are:

Location of Plant.	Source of Power.	H. P.	Voltage of Line.	Distance.
Fair Haven, Vt.	Water	300	2,200	7 and 11 miles.
Juiz de Fora, Brazil	Water	400	4,500	7 miles.
Quezaltenango, Guat.	Water	200	2,200	4½ miles.
West Brook, Me.	Water	100	200	½ mile.
Ward, Colo	Water	100	440	¾ mile.
Cumberland Mills, Me.	Water	600	8,000	5 miles.
Telluride, Colo. (mines)	Water	1,600	11,000	3 and 15 miles.
Sacramento, Cal.	Water	1,067	15,000	29 miles.
Harlford, Conn.	Water	3,200	10,000	11 miles.
Helena, Mont.	Water	3,467	11,000	11 and 16 miles.
Salt Lake City, Utah	Water	3,000	15,000	14 miles.
Concepcion, Mexico	Water	80		
Pt. Tampa, Fla.	Water	200	2,200	2½ miles.
Grosvenor Dale, Ct.	Water	400	2,200	3 miles.
Burlington, Vt.	Water	267	2,200	3½ miles.
Fitchburg, Mass.	Water	400	2,500	2½ miles.
Montpelier, Vt.	Water	400	10,000	6 and 12 miles.

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Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
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FOR 1897,

NOW READY.

Send 10 cents for a copy. Liberal discount if large quantities are ordered.

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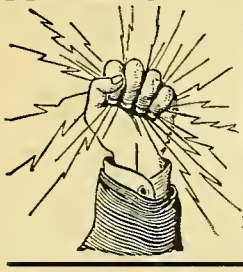

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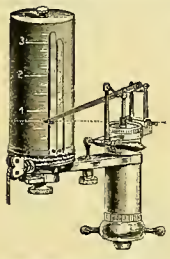

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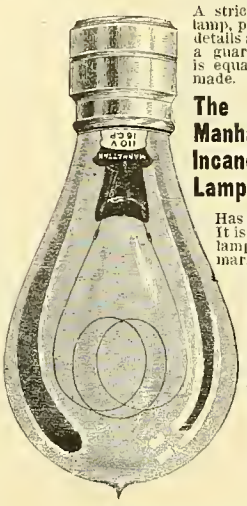

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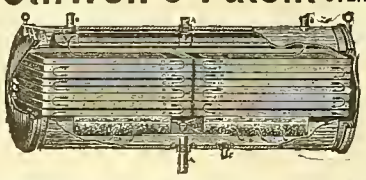

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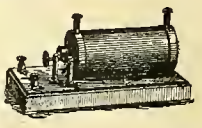

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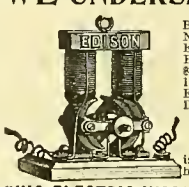

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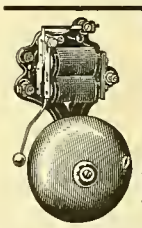

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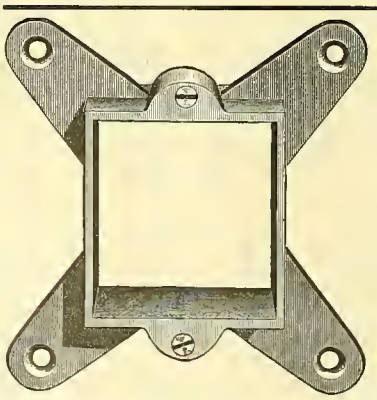

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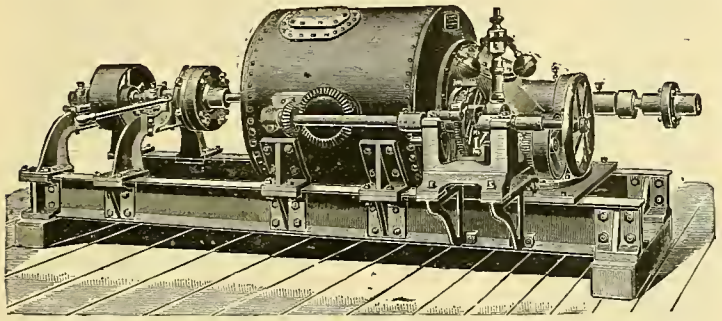

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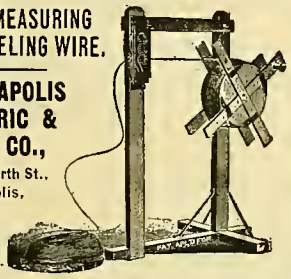

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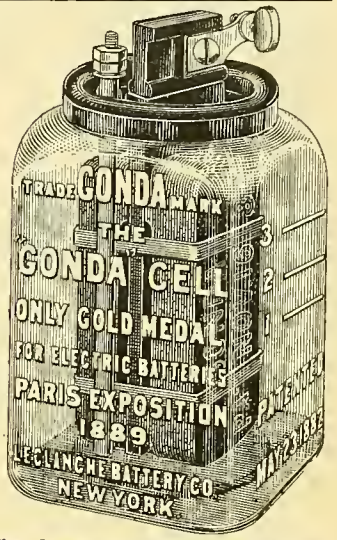

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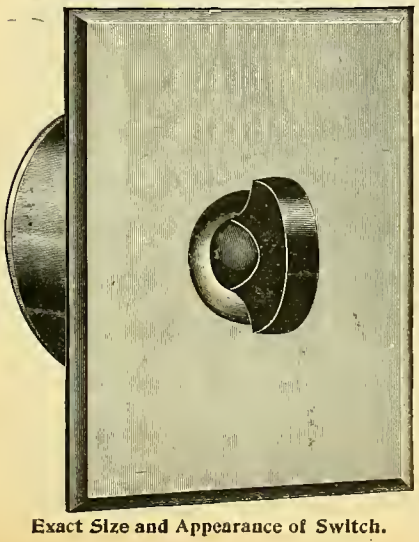

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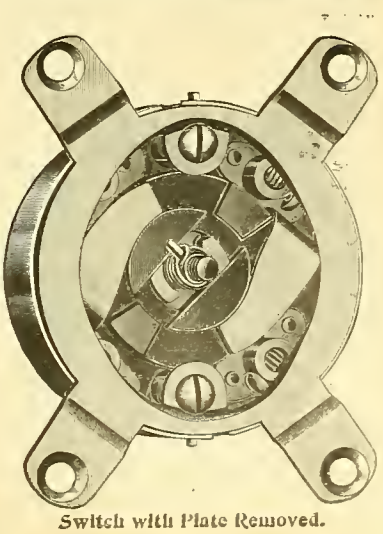
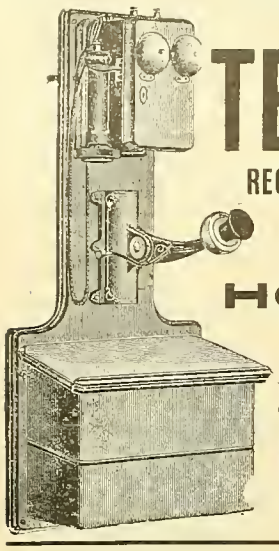


Switch with Plate Removed.



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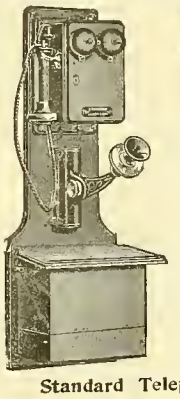

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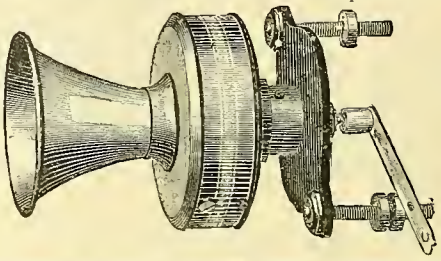

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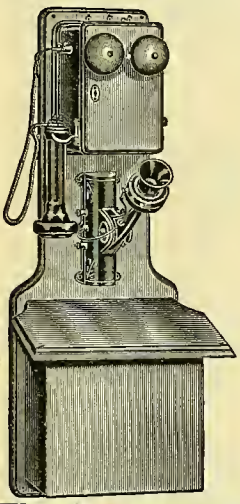

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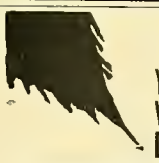

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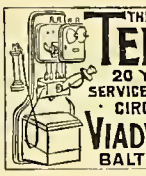

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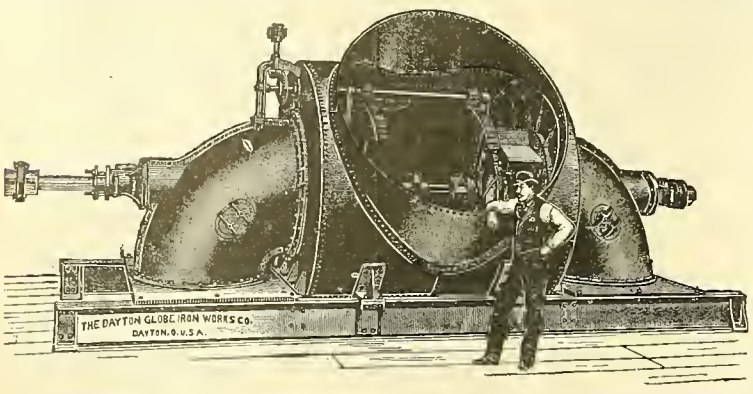

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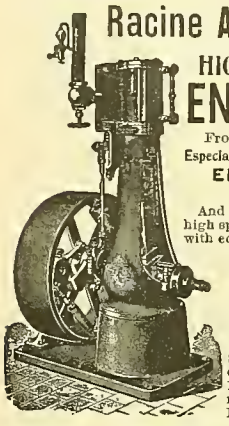

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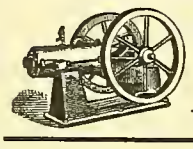

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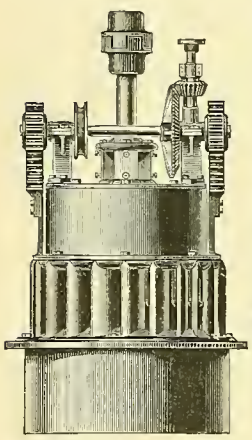

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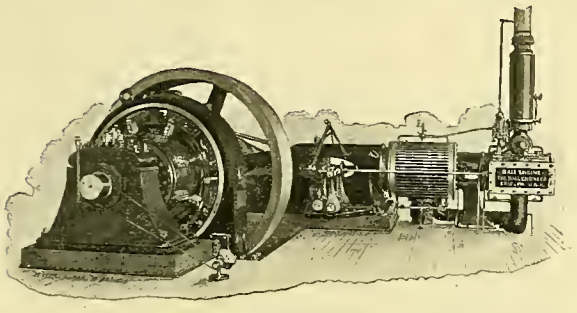

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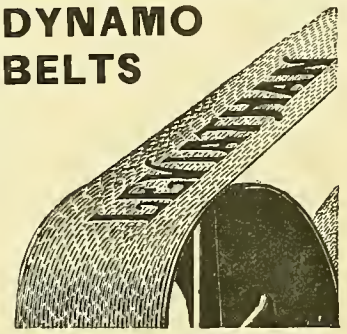

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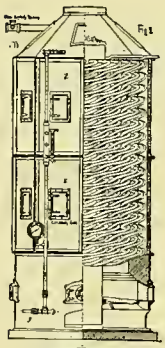

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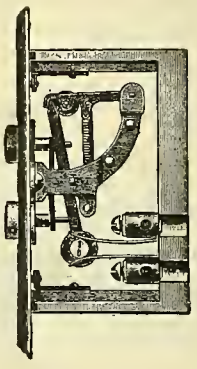

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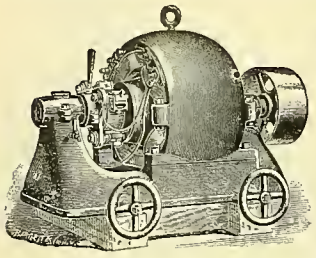

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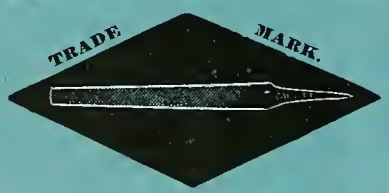

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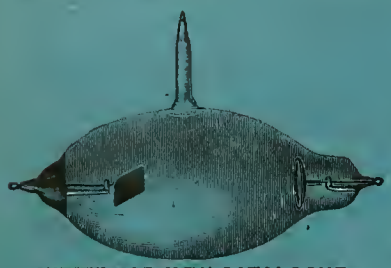

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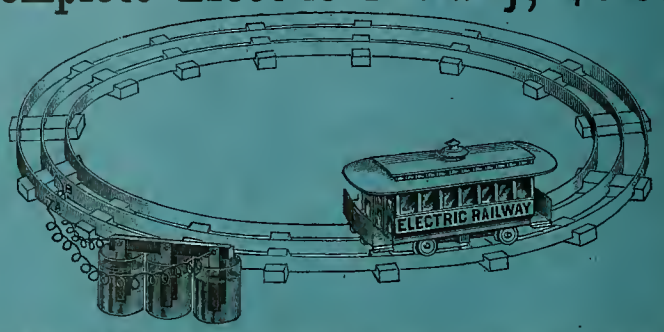

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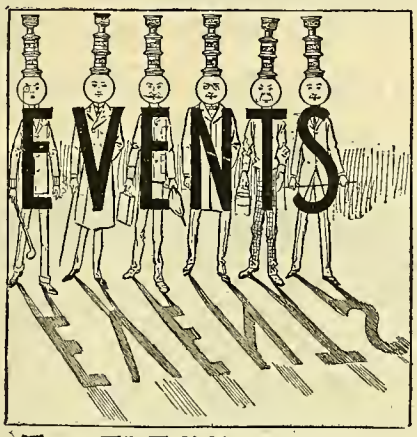

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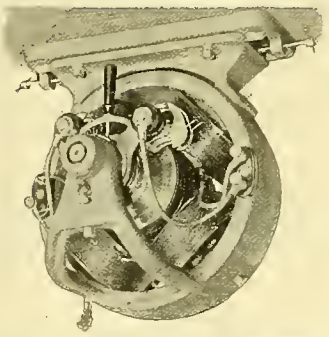

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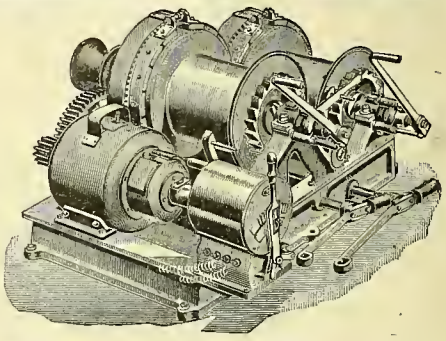

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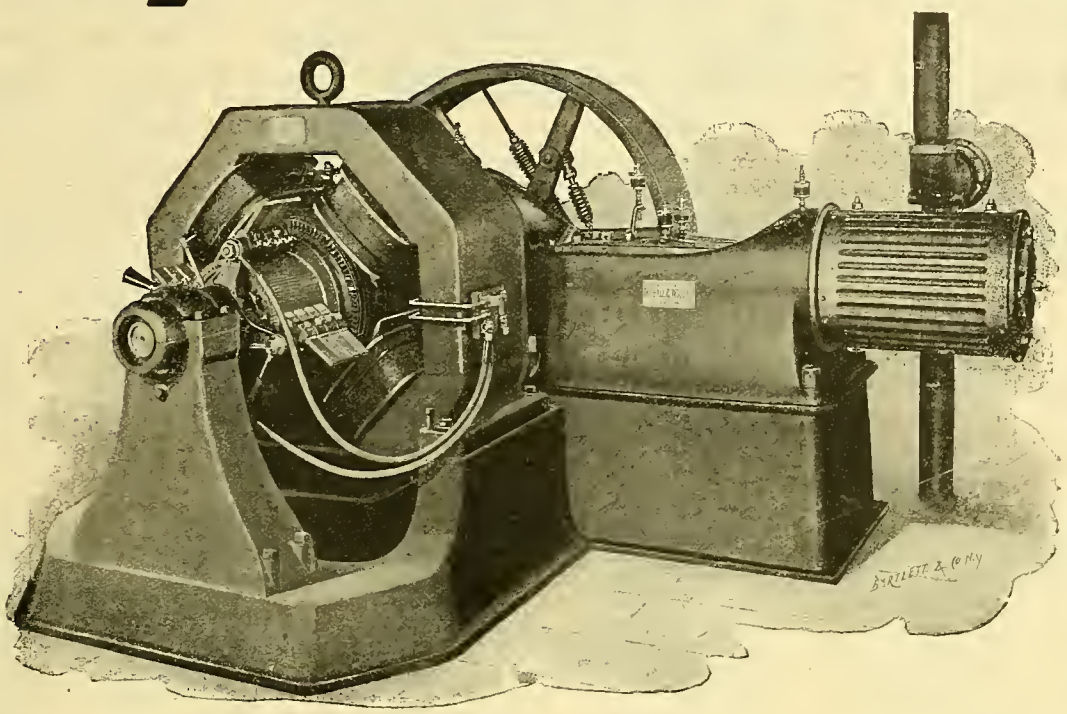

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Keystone El. Instrument Co.
McKeague, J. B.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.
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American Elec. Fuse Co.
American El. Heating Corp.
Andrae, J. & Sons Co.
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Carlisle & Finch.
Clymer & Heilman.
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Faries Mfg. Co.
Genor & Colburn.
Hill, Thos, Jr.
Imperial Porcelain Works.
Lever, C. H. Mfg. Co.
Metropolitan Electric Co.
Pacific Electric Co.
Partrick & Carter Co.
Peru Elec. Mfg Co.
White Co., The O. C.
Electrical Woodwork.
Lever, C. H. Mfg. Co.
Electro-Plating Mach'y.
Besly & Co., Chas. H.
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General Electric Co.
Jenney Elec. Motor Co.
Electrotypers.
Chic. Electro & Stereo. Co.
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Otto Gas Engine Wks.
Van Duzen Gas & Gso. En. Co.
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Ball Engine Co.
Philadelphia Eng. Works.
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Hunter Fan & Motor Co.
Interior Conduit & Ins. Co.
Westinghouse El. & Mfg. Co.
Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.
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Barnett Co., G. & H.
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Johns, H. W., Mfg. Co.
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Huebel & Manger.
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Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.
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Electric Appliance Co.
General Electric Co.
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National India Rubber Co.
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Okonite Co., The.
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Stilwell-Bierce Smith-Vaile.
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Swarts Metal Refining Co.
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Underwood & Co., H. M.
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Partrick & Carter Co.
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Whitney Elec. Inst. Co.
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Webster & Co., Warren.
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Electric Storage Battery Co.
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Faries Mfg. Co.
White Co., The O. C.
Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
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Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
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Electric Appliance Co.
Western Electric Co.
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Besly & Co., Chas. H.
Brixey, W. R.
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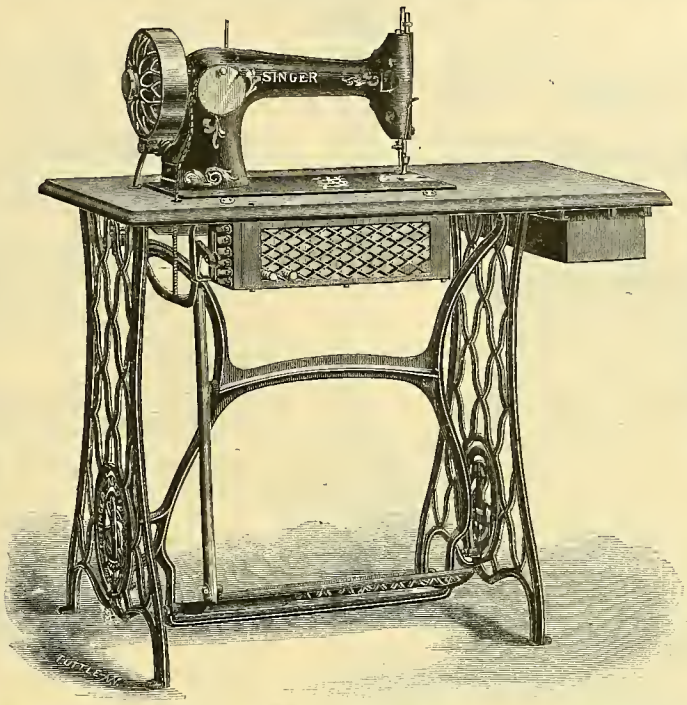
Diehl Balance Wheel Motors.

THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

MOTORS are entirely **SELF-CONTAINED** and replace the ordinary balance wheels.

THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



IN THIS MANNER

The highest economy is attained, because all objects intervening between the source and subject of power are dispensed with and the electric current is only used when the machine is running.

Write for catalogue.

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DYNAMOS & MOTORS

SLOW SPEED HIGH GRADE

THE CARD ELECTRIC CO.

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No Sparking Under Varying Load,
No Wear on the Commutator.

90% PURE GRAPHITE.

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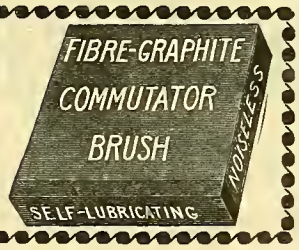

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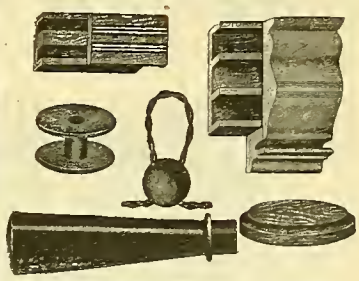
MANUFACTURE GENERAL ELECTRIC SUPPLIES

ANNUNCIATORS
BURGLAR & FIRE ALARMS
SIGNAL GONGS-BELLS etc.

Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 870 LBS.



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The "H. W. J." Electric Car Heater.

(PATENTED.)

Simplicity—Effectiveness—Durability—Economy.

No coils to short-circuit or break, no oxidation, perfect air circulation, easily controlled and regulated by patented knife switch. Adjustable to three different degrees of heat. Prices, etc., on application.

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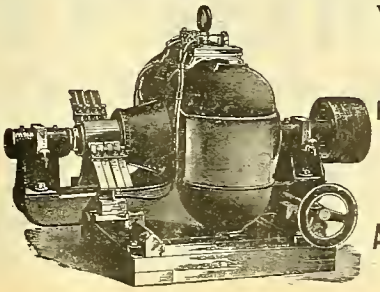
DALLETT
Electric Motors and Generators,

MANUFACTURED BY

THOS. H. DALLETT & CO.,

York St. and Sedgley Ave.,
PHILADELPHIA, PA.



Portable Electric Drills, Starting Boxes and Controllers,

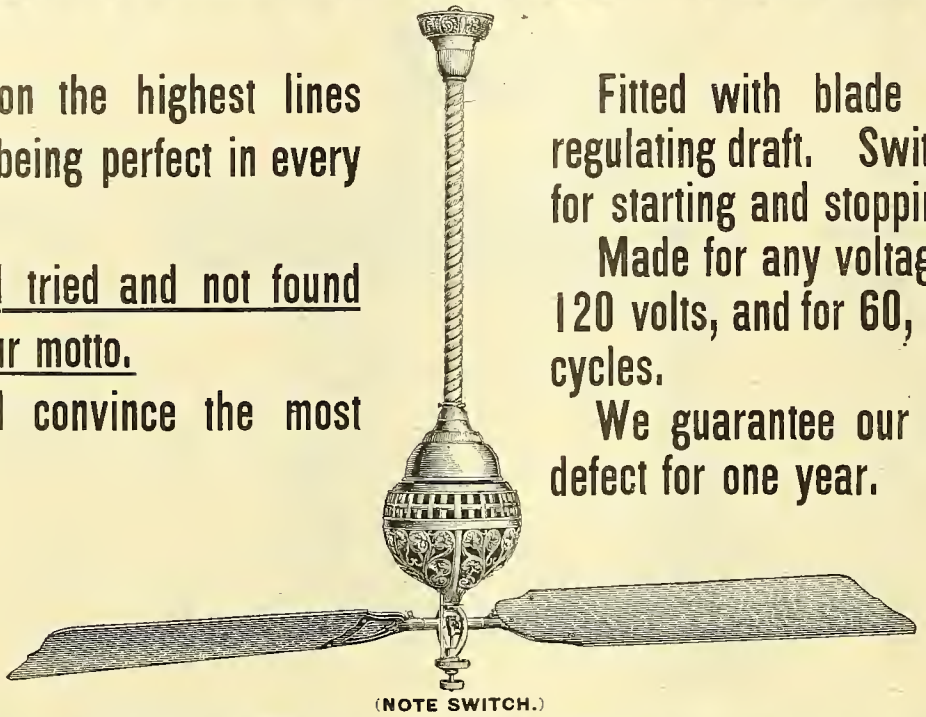
Automatic Switches. . . . . .
Flexible Insulated Couplings.

THE 1897 TUERK ALTERNATING CEILING FAN

Is designed on the highest lines of perfection, being perfect in every detail.

Tested and tried and not found wanting is our motto.

A trial will convince the most skeptical.



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Fitted with blade adjuster for regulating draft. Switch on bottom for starting and stopping.

Made for any voltage from 50 to 120 volts, and for 60, 125 and 140 cycles.

We guarantee our fans against defect for one year.

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Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

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TRIPLE BRAID, STRANDED AND SOLID WEATHER-PROOF WIRE!

WE ARE OVERSTOCKED.

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DEALERS IN ELECTRICAL MERCHANDISE OF ALL KINDS.

"THE ELECTRA"

ELECTRA ·TRADE MARK·

HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

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FOR ELECTRICAL USES:

Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.

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LA CLEDE BATTERIES
PORCELAIN INSULATION Of all Kinds. We Solicit the making of SPECIAL DESIGNS OF PORCELAIN.

"Just the Layout Needed."

writes a customer about "The Dealer's Assortment" of electric heating appliances sent with a showcase for $25.67. We have made radical improvements in electric heating devices, which are conspicuous. If you have not done so, order one of the "Dealer's Assortments" and be up to date. Everything guaranteed.

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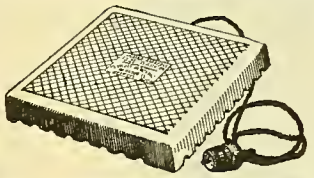

No Cold Feet

WITH THIS IMPROVED

Electric Foot Warmer!

Size 10x10x1½ inches. Has cord and plug, connects to any lamp socket, uses 50 Watts, handsomely nickel plated; portable, and **lies flat on the floor** or can be **adjusted to an angle.** Can be placed to the feet of an invalid in bed—nothing equals it! In ordering **state the voltage and kind of socket. Remit only $5.00** for bronze, or **$6.00 for nickeled style,** and receive a sample by return express.

CAR HEATER AND HOUSE RADIATOR.

We have **THE BEST Car Heaters, Portable Stoves, Radiators, Disks, Cooking Utensils, Sad Irons, Laundry Irons, Tailor's "Goose," Ovens, Broilers, Water Heaters, Curling Iron Heaters, etc.** Latest improvements, high efficiency; safe, reliable and durable. Last, but not least, all goods are **"repairable"** at small expense.

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SUBJECT—"TWO GOOD THINGS."

HURRAH! HURRAH!! HURRAH!!!

Quit your yelling, you blamed idiot you! Don't you know half our customers voted for Bryan!

MARCH 4th, '97!

TRY US!

INCIDENTALLY.—

Of course you know we're agents for **Interior Conduit** (when we say "we" we don't, of course, include Maj. McKinley!) Like all other standards, this material will probably be imitated. However, **the broad, fundamental patents covering the process of manufacture prevent even a near approach to the features wherein lie the strength and integrity of insulation possessed by it.** It possesses advantages in that it is extremely light, has a smaller outside diameter for a given inside diameter, and moreover, has greatly increased insulating properties.

Try Us on Prices.

A USEFUL INSTRUMENT!

S. K. C.

STATIC GROUND DETECTOR.

CONSUMES NO ENERGY.

CAN BE LEFT IN CIRCUIT CONTINUOUSLY.

ABSOLUTELY RELIABLE.

DESIGNED FOR ANY E. M. F. FROM 500 TO 10,000 VOLTS.

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THE S. K. C. SYSTEM.

A COMPLETE SYSTEM FOR

Long Distance Transmission, General Station Distribution, Mill and Factory Equipment.

Generators will be wound and guaranteed for an E. M. F. as high as

10,000 VOLTS.

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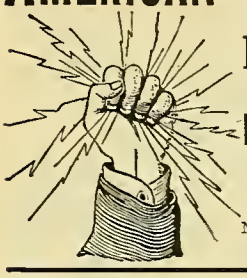
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
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Patented.

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HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

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FACTORIES, MUNCIE, IND.

THE ONLY

WATER-WHEEL GOVERNOR

THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
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GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
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The largest makers of all sizes and kinds of Special Wrought Mild Steel and best Wrought Iron Tubular Goods in the world, control the manufacture of Wrought Tubular Goods made of a high class of mild steel from the ore to the finished product, and unqualifiedly recommend National Steel Pipe for all uses as better than any iron pipe made.

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Any pattern. Write for prices.

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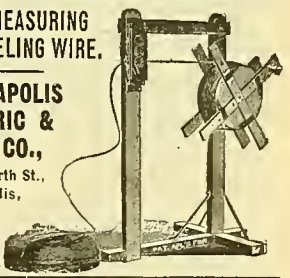
If your wires are going underground, write

THE H. B. CAMP CO.,
AULTMAN, OHIO,

Manufacturers of the conduit used by the largest telephone and telegraph companies. Will furnish any information desired.

An Efficient Device

FOR MEASURING AND REELING WIRE.



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GOOD AS GOLD. Exceptionally good opportunity for profitable investment in stock of MICA MINING COMPANY just organizing. Small capitalization, large profits.

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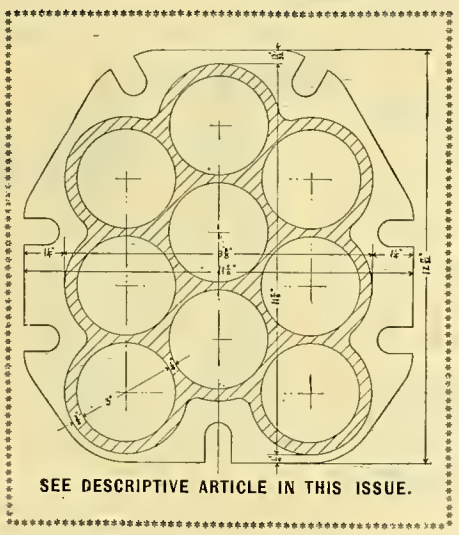

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MADE OF FINE CAST-IRON.

EVERLASTING. GREATEST DURABILITY.

Cheap as any other Conduit. Far superior to all others. Preserves the insulation. Strongly endorsed by prominent engineers.

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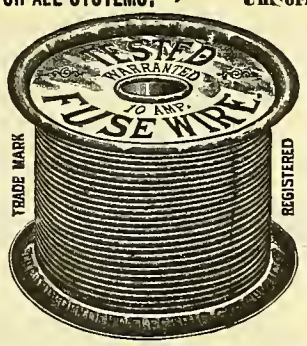

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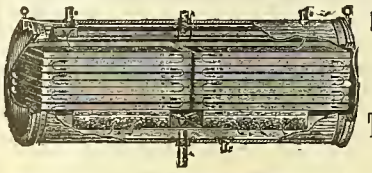

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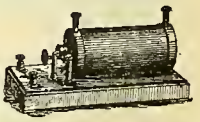

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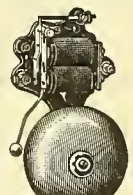

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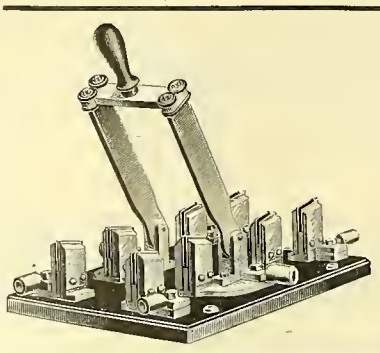

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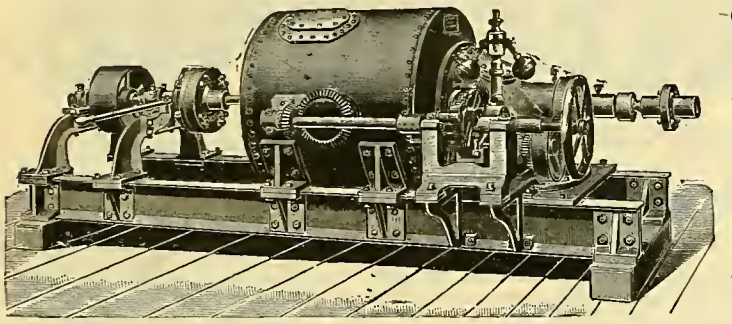

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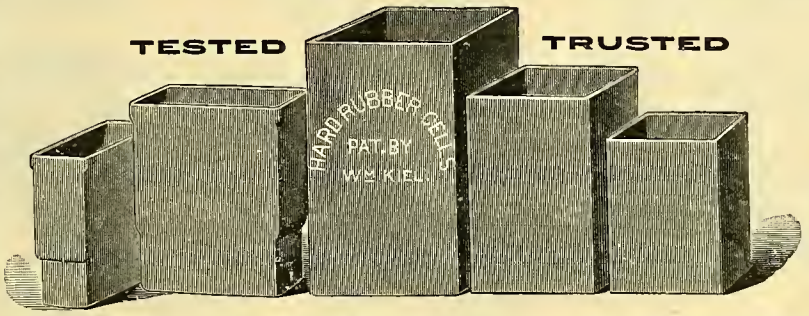

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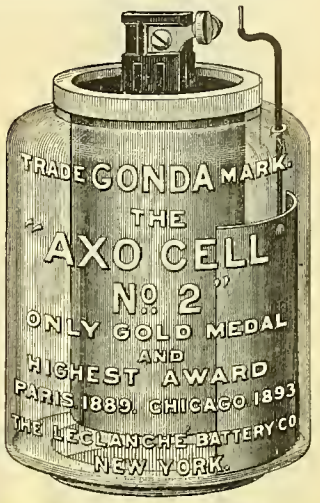

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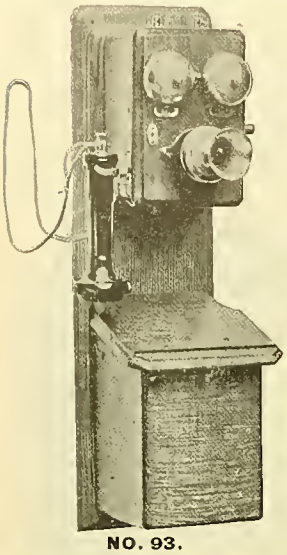

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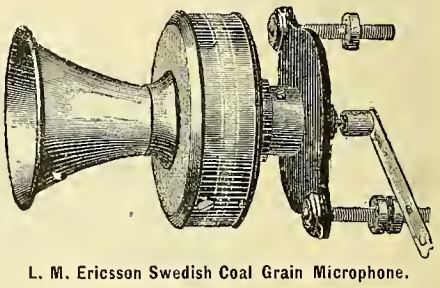

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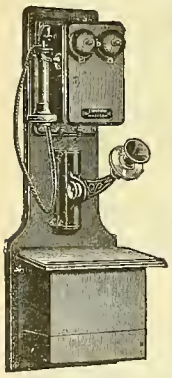

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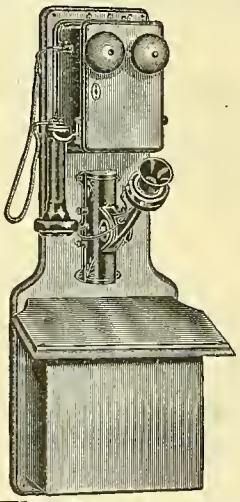

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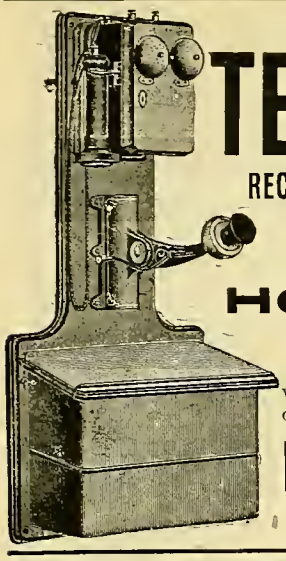

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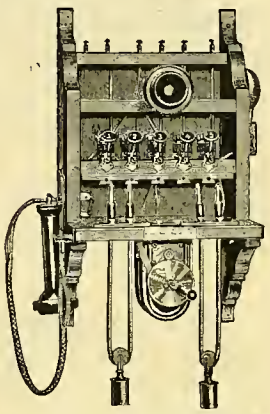

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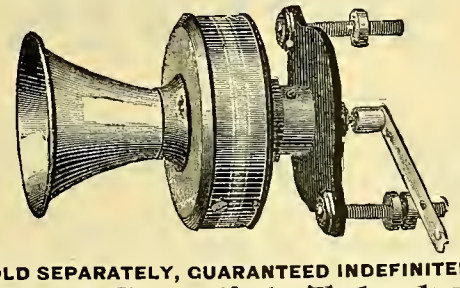

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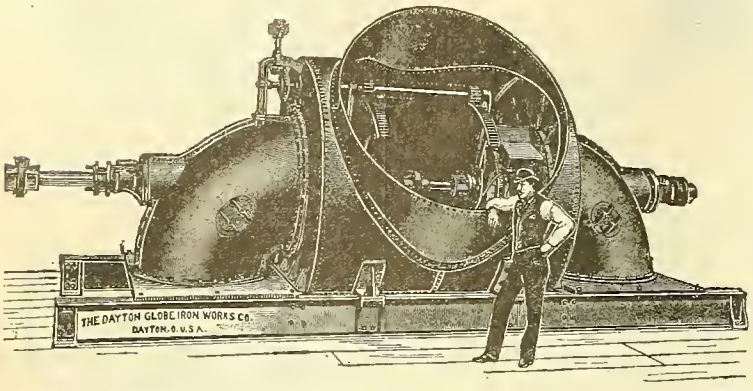

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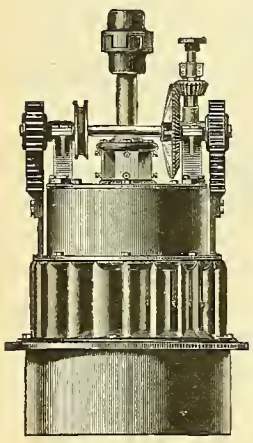

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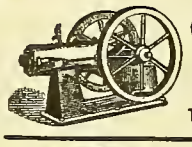

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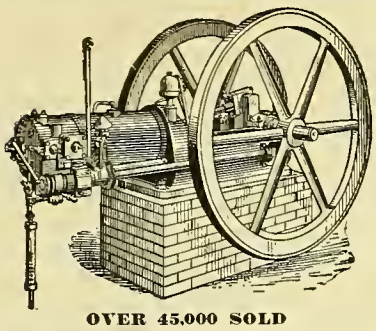

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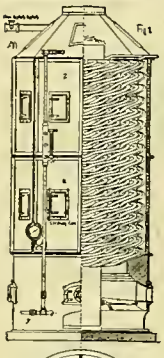

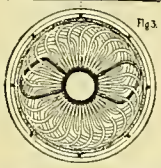

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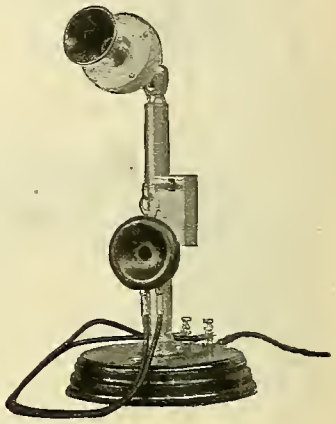

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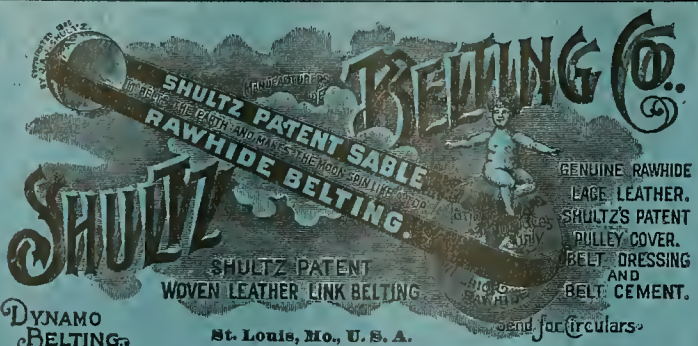

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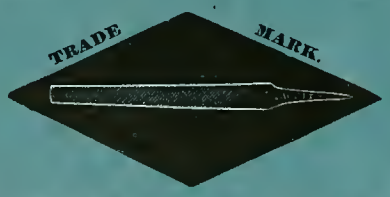

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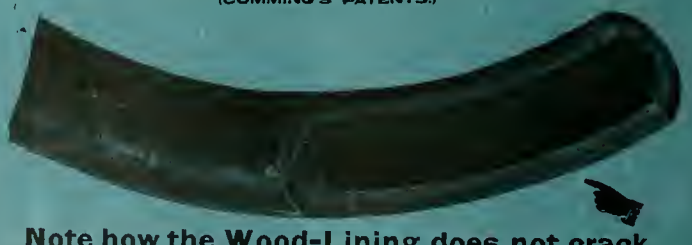

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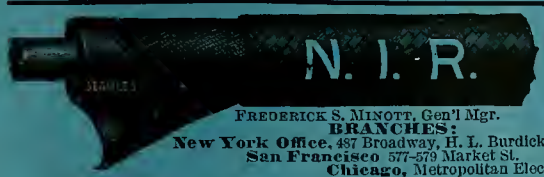

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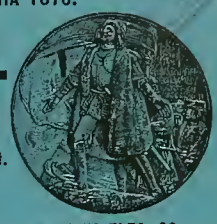

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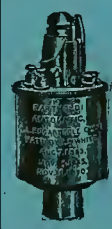

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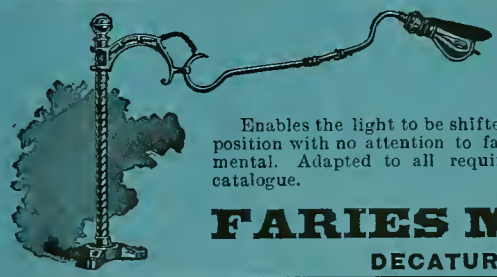

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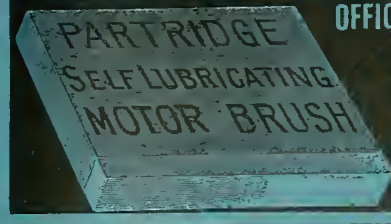

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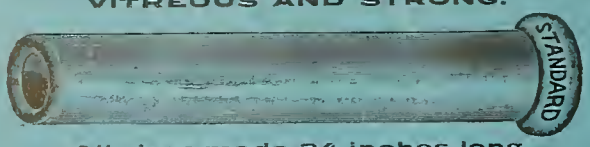

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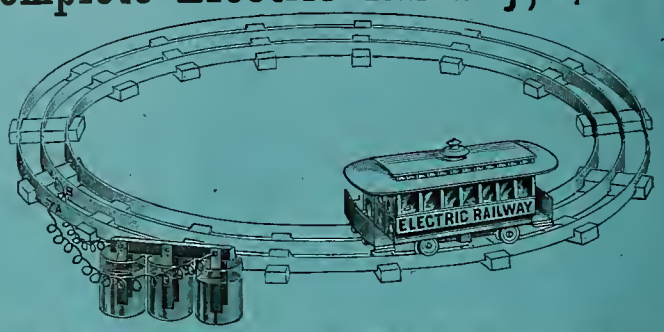

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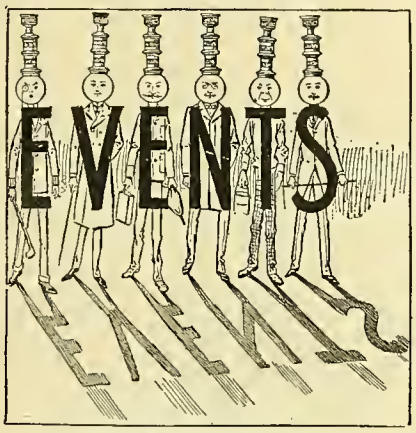

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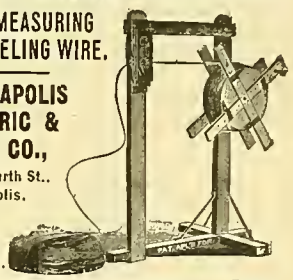

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Wirt, Cnas iii

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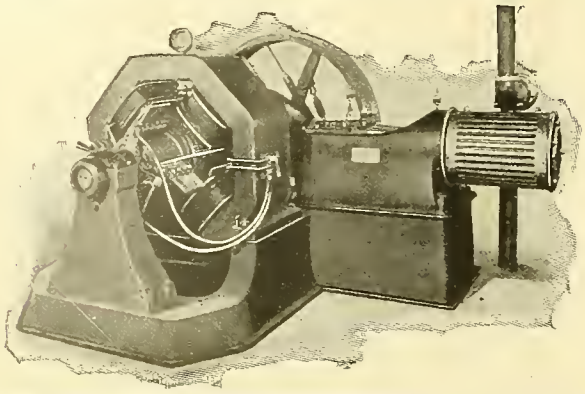
EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



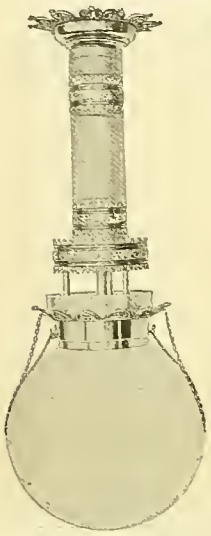
Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.



Upton Long Burning ARC LAMP.

FOR DIRECT CURRENT LOW POTENTIAL CIRCUITS.

No Mechanism; No Parts to Gum or Wear. No Shadow. No Carbon or Guide ods to Clean and Polish. Absolutely Steady White Light. Burns 150 Hours on 4½ Amperes without Trimming. Cheaper than any Long Burning Lamp on the Market.

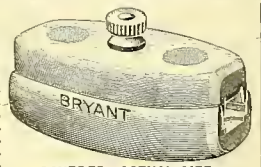
We manufacture Arc Lamps for all circuits. Write us before placing your orders.

STANDARD THERMOMETER & ELECTRIC CO.,

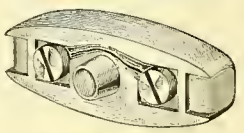
PEABODY, MASS.

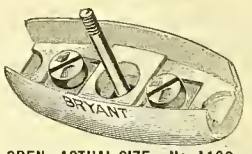
BRANCH OFFICES:
ELECTRIC APPLIANCE CO., 242 Madison Street, Chicago, Ill.
F. L. HAVILAND, 253 Broadway, New York.
STANDARD THERMOMETER & ELECTRIC CO., John Hancock Building, Boston, Mass.
DUNHAM, CARRIGAN & HAYDEN CO., San Francisco, Cal.

WRITE FOR CATALOGUE E, 31.



COVERED—ACTUAL SIZE.





OPEN—ACTUAL SIZE. No. 1106.

No. 1106 Bryant Bug Covered Cut-Out.

ONE NUT ONLY.

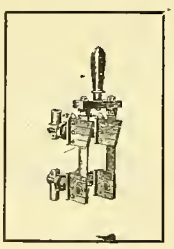
Impossible to Short Circuit.
Fuse in Cap Not in Base.

Not necessary to disturb CONNECTING WIRES in replacing FUSE. Write your supply house for samples and price. If they cannot furnish, write us direct.

Bryant Electric Co.,

BRIDGEPORT, CONN.
CHICAGO, ILL.

We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.



A quick break switch, made in sizes from 50 amperes capacity to 800 amperes. They will be listed in our new catalog. We manufacture arc and incandescent dynamos and direct current motors. Also arc lamps.

We have in stock in our Chicago Store

WAITING FOR YOUR ORDERS

Sockets, Switches, Cut-Outs,
Tubes and Insulators,
Shawmut Fuse Wire and Knife Switches,
Bells, Annunciators,
Batteries, Push Buttons,
Fan Motors, Electric Supplies of all Kinds.

Western Electric Company.

Chicago. New York.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.

Portable Heater for residences and offices, size 23 inches long, 11½ inches high, 5 inches wide. Weight 30 pounds.

Highest Efficiency, Simplicity, Durability, Production Guaranteed. Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

Heating coils renewed like incandescent lamps. Constructed for any voltage. Work on direct or alternating current. Consumes 6. 8 amperes on 110 volt current, 1. 5 on 500 volt current.

THE GLOBE ELECTRIC HEATING CO., 147 North 12th Street, Philadelphia, Pa.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

PITTSBURG, PA.

New York, 120 Broadway.
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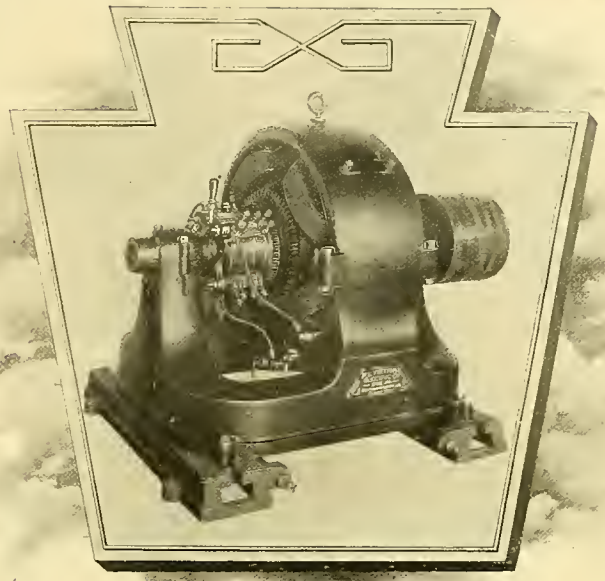
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S.W., England.
32 Ave. de l'Opera, Paris, France.
For Canada address Ahearn & Soper, Ottawa, Ont.

KEYSTONE ELECTRIC

Erie,



Penn.

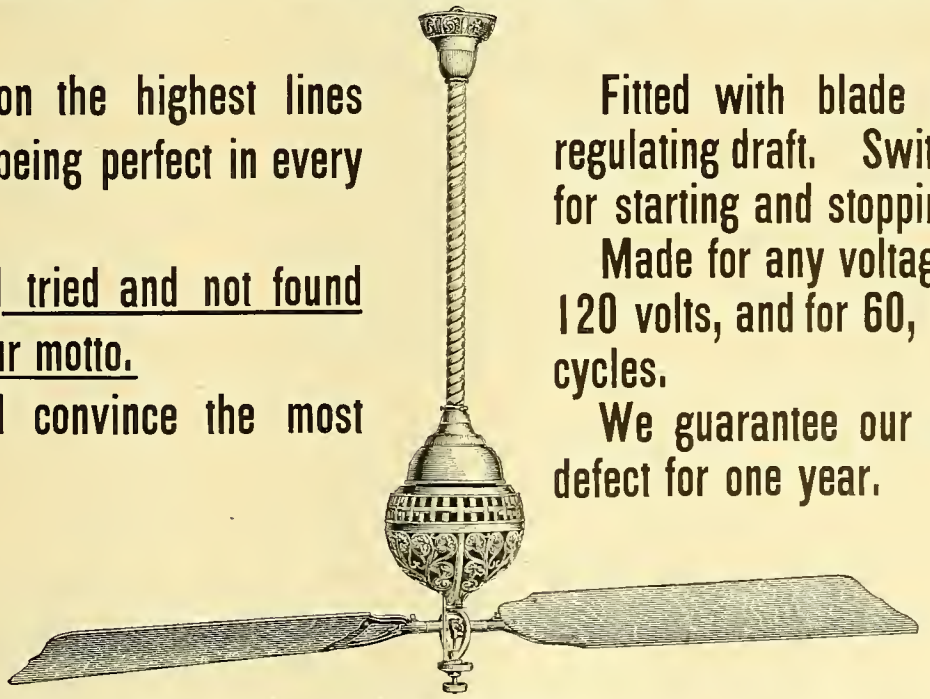
COMPANY.

THE 1897 TUERK ALTERNATING CEILING FAN

Is designed on the highest lines of perfection, being perfect in every detail.

Tested and tried and not found wanting is our motto.

A trial will convince the most skeptical.



(NOTE SWITCH.)

Fitted with blade adjuster for regulating draft. Switch on bottom for starting and stopping.

Made for any voltage from 50 to 120 volts, and for 60, 125 and 140 cycles.

We guarantee our fans against defect for one year.

FOR FULL PARTICULARS AND PRICES WRITE FOR '97 CATALOGUE.

Hunter Fan and Motor Company, Fulton, N. Y.

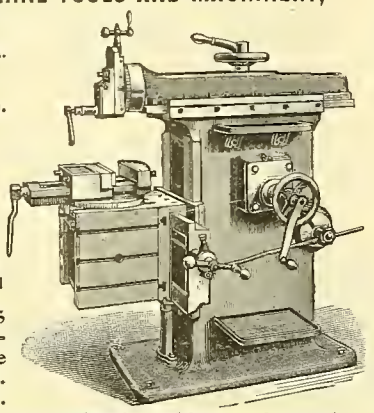
E. R. LATHAM & CO., GENERAL EASTERN AGENTS, 136 LIBERTY ST., NEW YORK.

The Garvin Machine Co.,

MANUFACTURERS OF MACHINE TOOLS AND MACHINERY,

SPRING & VARICK STS., NEW YORK.
51 N. SEVENTH ST., PHILADELPHIA.

WESTERN AGENCY:
Fay & Egan Co., 22 S. Canal St., Chicago.



METAL WORKING MACHINERY.

Our facilities for equipping PLANTS engaged in the manufacture of ELECTRICAL goods are unquestionably the best of any concern in the country. We have in stock over 500 machines. Write us for No. 18 list of new and second-hand machinery. It may be of value to you.

NEW EDITION,
CROSBY & BELL'S ELECTRIC RAILWAY,
JUST OUT. PRICE $2.50. SEND FOR IT.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO.

CHICAGO GENERAL FIXTURE CO.,

169 ADAMS ST., CHICAGO, ILL.

Electrical Supplies AND Fixtures

AT RIGHT PRICES.

CLASSIFIED INDEX OF ADVERTISEMENTS.

Accumulntors.
Electric Storage Battery Co.

Annnnciators.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

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Bullock Elec. Mfg. Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Diehl Mfg Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
Keystone Electric Co.
Manhattan Gen'l Cons. Co.
Perkins Elec. Switch Mfg. Co.
Puritan Electric Co.
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Westinghouse El. & Mfg. Co.

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Commercial El. Supply Co.
Edison Mfg. Co.
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Genor & Colburn.
Leclanche Battery Co., The.
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Midland Electric Co.
Ohio Electric Works.
Peru Elec. Mfg. Co.
Western Electric Co.

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Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
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Electrician Publishing Co.

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Phosphor Bronze Sm. Co., Ltd.

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Holmes Fibre-Graphite Co.
McKeague, J. B.
Partridge Carbon Co.
Wirt, Chas.

Burglar Alarms.
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Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.
Western Electric Co.

Cables (See Insulated Wires.)

Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
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Okonite Co.
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Davis, L. W.
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Hodge, Walsh & Loring.
Keystone Electric Co.

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Ahlm-Edwards El. Co.
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Arnold, B. J.
Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
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Keystone Electric Co.
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Patitz, A. M.
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Triumph Electric Co.
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Mansfield Temp. Copper Co.
McDermid Mfg. Co.

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Metropolitan Electric Co.
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Standard Underground C. Co.
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Edison Mfg. Co.
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Perkins Elec. Switch Mfg. Co.
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Card Electric Co.
Clymer & Heilman.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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General Electric Co.
Jenney Elec. Motor Co.
Keystone Electric Co.
Northern Electl. Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Westinghouse El. & Mfg. Co.

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Fuel Economizer Co.

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General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
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Bain, Foree.
Bryan & Humphrey.
Eddy Elec. Mfg. Co.
McRae, A. L.
Patitz, A. M.
Pratt, Chas. A.

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Chicago Edison Co.
Clymer & Heilman.
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Cutter El. & Mfg. Co.
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Gilmore El. & Mfg Co.
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Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

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American El. Heating Corp.
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Bryant Electric Co.
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Clymer & Heilman.
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Faries Mfg. Co.
Genor & Colburn.
Imperial Porcelain Works.
Lever, C. H. Mfg. Co.
Metropolitan Electric Co.
Pacific Electric Co.
Partrick & Carter Co.
Peru Elec. Mfg. Co.
White Co., The O. C.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

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Besly & Co., Chas. H.
Colburn El. Mfg. Co.
General Electric Co.
Jenney Elec. Motor Co.

Electrotypers.
Chic. Electro & Stereo. Co.

Engines, Gas
Otto Gas Engine Wks.
Van Duzen Gas & Gso. Eo. Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Philadelphia Eng. Works.
Racine Hardware Co.
Weston Engine Co.

Fan Outfits.
Commercial El. Supply Co.
Hunter Fan & Motor Co.
Interior Conduit & Ins Co.
Westinghouse El. & Mfg. Co.

Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

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Western Electric Co.

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Chicago Gen'l Fixture Co.
Commercial El. Supply Co.

Fuse Wire.
Brixey, W. R
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co
General Electric Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Bogart, A. L.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies
Andrae, J. & Sons Co.
Besly & Co., Chas. H.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Clymer & Heilman.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Elec. Sup. & Telep Co.
Electric Appliance Co.
General Electric Co.
Genor & Colburn.
Gilmore El. & Mfg. Co.
Hill, W. S. Elec. Co.
Hodge, Walsh & Loring.
Huebel & Manger.
Interior Conduit & Ins. Co.
International Elec. Co.
Johns, H. W., Mfg. Co.
Metropolitan Electric Co
Midland Electric Co.
Minneapolis El. & Cons. Co.
Ohio Electric Works.
Pacific Electric Co.
Partrick & Carter Co.
Peru Elec. Mfg. Co.
Sioux City Brass Works.
Westinghouse El. & Mfg. Co.

Globes and Electrical Glassware.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Hemingray Glass Co

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

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Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulntors and Insulating Materials.
Akron Ins. & Marble Co.
Andrae, J. & Sons Co.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Chicago Edison Co.
Commercial El. Supply Co.
Delaware Hard Fibre Co.
Electric Appliance Co.
Empire China Works.
Gilmore El. & Mfg. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hodge, Walsh & Loring.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Locke, Fred. M.
McKeague, J. B.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Alternating.
Puritan Electric Co.

Lamp Shades.
Pacific Electric Co.
Underwood & Co., H. M.

Lamps, Incandescent.
Buckeye Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Edison Dec. & M. Lamp Dept.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.,
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Westinghouse El. & Mfg. Co.

Lightning Arresters.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Robertson & Sons, J. L.
Stilwell-Bierce Smith-Vaile.

Mica.
Commercial El. Supply Co.
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
Bullock Elec. Mfg. Co.
General Electric Co.
Keystone Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Brush Electric Co
Bullock Elec. Mfg. Co.
Card Electric Co.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Dallett & Co, Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
Jenney Elec. Motor Co.
Keystone Electric Co.
Metropolitan Electric Co.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Westinghouse El. & Mfg. Co.

Oil Filters.
Metropolitan Electric Co.

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Brown, DeWitt, Cedar Co.
Hart, C. S.
Lindsley Bros.
Perrizo & Sons.
Tagatz, H. A.

Porcelain.
Akron Ins. & Marble Co.
Bryant Electric Co.
Commercial El. Supply Co.
Empire China Works.
General Electric Co.
Imperial Porcelain Works.
McKeague, J. B.
Peru Elec. Mfg. Co.

Publishers, Electrical.
Electrician Publishing Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Reels, Wire.
Minneapolis El. & Cons Co.

Refiners.
Swarts Metal Refining Co.

Re-Winding.
Chicago Edison Co.
Electrical Exchange, The
Hodge, Walsh & Loring.

Rheostats.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Westinghouse El. & Mfg. Co.

Sal Ammoniac.
Klipstein & Co., A.

Search Lights.
Carlisle & Finch.

Second-Hand Machin'y.
Electrical Exchange, The.

Shade Holders.
Underwood & Co., H. M.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Steam Gauges.
Robertson & Sons, J. L.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
Electric Storage Battery Co.

Supporters, Inc. Lamp.
Faries Mfg. Co
White Co., The O. C.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Commercial El. Supply Co.
Electric Appliance Co
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telegraph Apparatus.
Electric Appliance Co.
Western Electric Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Andrae, J. & Sons Co.
Clark Tel. & Const. Co.
Commercial El. Supply Co.
DeVeau & Co.
Elec. Sup. & Telep Co.
International Elec. Co.
Kusel, D. A. Tel. Mfg Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Standard Tel. & El. Co.
Viaduct Mfg. Co.
Western Electric Co.
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Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Universities.
Int. Corr. Schools.

Water Wheels.
Dayton Globe Iron Works Co
Leffel & Co., Jas
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Wire, Bare.
Besly & Co., Chas H.
Brixey, W. R.
Commercial El. Supply Co.
Electric Appliance Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
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American Elec. Fuse Co.

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Edison Dec. & M. Lamp Dept
Edison Mfg. Co.
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For Alphabetical Index of Advertisements See Page 11

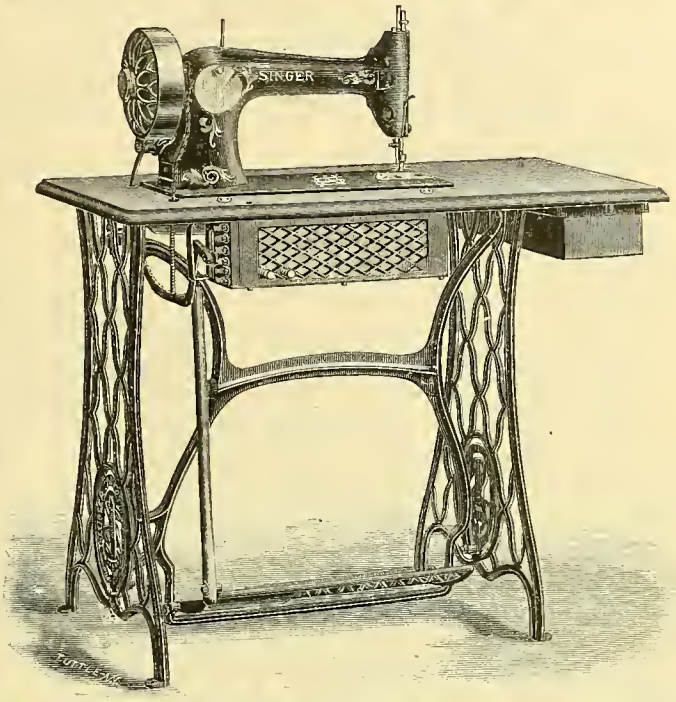
Diehl Balance Wheel Motors.

THE ONLY MOTOR

That can be directly coupled to the shafts of sewing machines.

MOTORS are entirely **SELF-CONTAINED** and replace the ordinary balance wheels.

THE RHEOSTAT is so arranged beneath the table that the machine can be started and stopped or the speed regulated simply by foot pressure upon the treadle.



IN THIS MANNER

The highest economy is attained, because all objects intervening between the source and subject of power are dispensed with and the electric current is only used when the machine is running.

Write for catalogue.

DIEHL MANUFACTURING CO.,

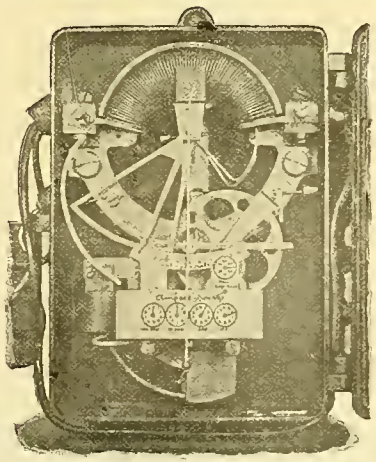
ELIZABETHPORT, N. J.

SHOWROOMS: 561-563 BROADWAY, NEW YORK CITY; 128-132 ESSEX STREET, BOSTON.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



3-Wire 22-Light Meter. Case Open, Showing Mechanism.

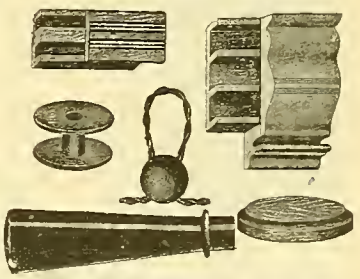
The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 870 LBS.

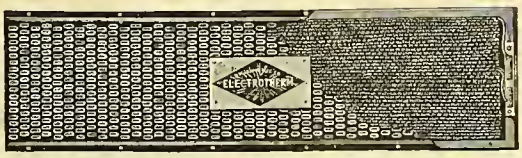


Electrical and Small Woodwork a Specialty.
Send for catalogue.

C. H. LEVER MFG. CO., CHICAGO.

The "H. W. J." Electric Car Heater.

(PATENTED.)



Simplicity—Effectiveness—Durability—Economy.

No coils to short-circuit or break, no oxidation, perfect air circulation, easily controlled and regulated by patented knife switch. Adjustable to three different degrees of heat. Prices, etc., on application. . . . . .

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New York. Philadelphia. Boston.

THE DUGGAN CLEAT

LEADS THEM ALL.

When ordering see that you get the DUGGAN.

Made in one wire No. 4, 5 and 6.
Two wire No. 2 and 3.
Three wire No. 1.

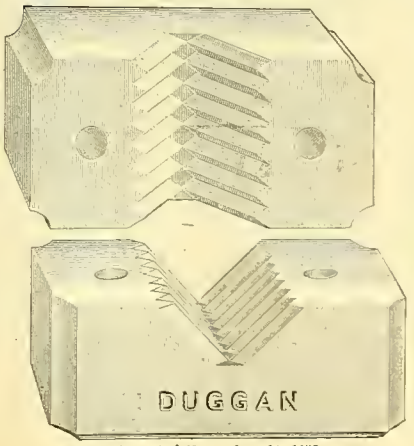
They are corrugated and V-shaped groove.

They grip like a vise.

No sagging wire when once stretched.

They are made of the finest glazed porcelain. Ten of them used to one of any other make.

No. 1, 3 and 4 holds wire 16 to 8.
No. 2 and 5 holds wire 6 to 00.
No. 6 hold wire 000 and larger.



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Imperial Porcelain Works,

J. B. McKEAGUE, Western Manager,
369 Wabash Ave., Chicago, Ill.

FACTORY, TRENTON, N. J.
Porcelain Specialties of all kinds.

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OF CINCINNATI, OHIO,

FORMERLY

The Card Electric Motor & Dynamo Co.

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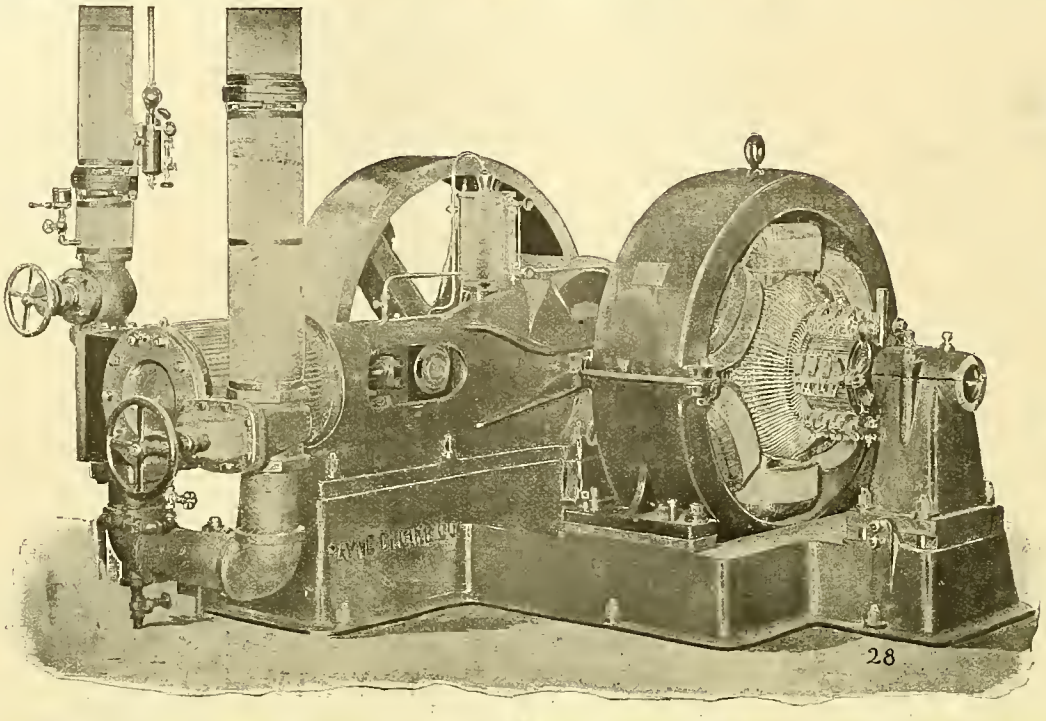
No. 14 Temple Court Building, Spokane, Washington.

No. 1724 Champa St., Denver, Colo.

No. 235 Fifth Street, Louisville, Ky.

No. 911 Market St., St. Louis, Mo.



Eastern Sales Agents:

The Bullock Electric Company, St. Paul Building, New York, N. Y.

No. 665 Bourse Building, Philadelphia, Pa.

No. 8 Oliver Street, Boston, Mass.

The Above Cut Shows One of Our Multipolar Engine Type Generators.

No More Liquid Batteries.

THE ROYAL COMBINES BEST FEATURES OF LIQUID AND DRY BATTERIES.

—ADVANTAGES:—

No action until water is added, hence can be kept in stock for years.
Especially adapted for export, as extremes of temperature will not affect it.
For open circuit work only.
E. M. F. 1.50 on open circuit. } Guaranteed.
Amperage 3. on short circuits. }
Size 5⅞" by 2¼", weight 1¼ lbs.

PRICE 50 CENTS.

Samples sent to any part of U. S. A. on receipt of 75 cts.
Liberal arrangements made with trade.

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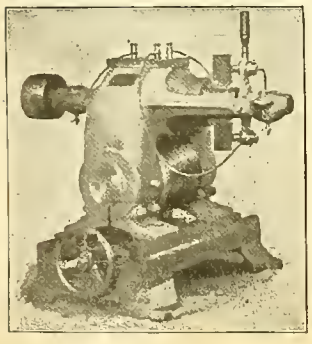
BUCKEYE

QUALITY UNEQUALED
FACTORY PRODUCTION TRIPLED.

INCANDESCENT LAMPS.

Monadnock Building, Chicago. **THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.**



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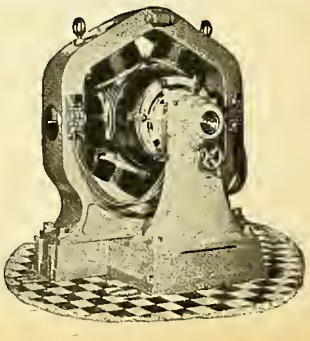
Jenney Electric Motor Co.,

300 La Salle Street, Indianapolis, Ind.



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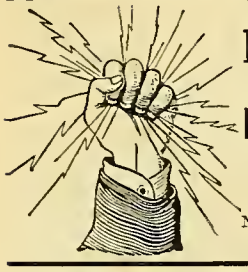
AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

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THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.

All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

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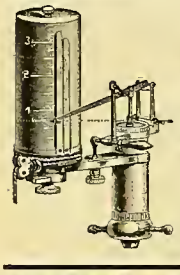
HERBERT H. EUSTIS, Pres. and Electrician.

61-63 Hampshire Street,
BOSTON, MASS.



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Seems large, but we claim that an *Indicator* at $40 will enable you to run your *engine* more economically; that *"Eureka" Packing* will create less friction and last three to four times longer than any other; that our *Separator, Oil Extractor, Feed Water Heater, Damper Regulator* and other appliances are equally profitable. Send for our catalogue.

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SUCCESSORS TO HINE & ROBERTSON CO.,
76 Cortlandt Street, New York.

Patented.

No. 11 DOUBLE GROOVE PONY INSULATOR

HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

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The largest makers of all sizes and kinds of Special Wrought Mild Steel and best Wrought Iron Tubular Goods in the world, control the manufacture of Wrought Tubular Goods made of a high class of mild steel from the ore to the finished product, and unqualifiedly recommend National Steel Pipe for all uses as better than any iron pipe made.

SAL AMMONIAC.

(ELECTRIC BRAND.)

FOR ELECTRICAL PURPOSES.

Guaranteed 98/99 per cent. and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

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We have the Largest and Most Complete Electrical

REPAIR SHOPS

In the West. ELECTRICAL REPAIRS AND MACHINE WORK OF EVERY DESCRIPTION. In having your repair work done by a company operating hundreds of dynamos and motors you are sure of good work and get the benefit of our experience. NO SCRAP WIRE USED.

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Empire China Works.
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GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &c
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EVERYTHING IN WIRE.

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ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

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Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

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Electric Lighting Plant

In a good Illinois town of about 3,000 people. Enquire

A. M. SEARLES, 1202 FISHER BLDG., CHICAGO.

FOR SALE.

Two 3 h. p. Motors; three 4 h. p. Motors; two 5 h. p Motors; eight 50 light Dynamos; two 135 light Dynamos; one 450 light Dynamo; one 45 k. w Alternator; two 50 k. w. Alternators; one 60 k. w. Alternator; one 75 k. w. Alternator. **V. J. MAYO,** 100 N Clinton St., Chicago.

FOR SALE.

20,000 SOLDERING STICKS for sale cheap. Send 10 cents for sample stick by mail. **R. W. SCHMELZ,** Jacksonville, Florida.

FOR SALE.

Nine 50-light T.-H. arc dynamos; one 12-light T.-H. arc dynamo; two 1,300-light T.-H. incandescent dynamos; one 1,000 light T.-H. incandescent dynamo; one T.-H. power generator, 62 k. w.; one Westinghouse power generator, 75 k. w. All been through fire. Would like to sell or receive an estimate on repairs.

Economy Light & Power Co.,
816 Marquette Bldg., Chicago.

FOR SALE.

One double crank power Ferracute press for stamping out armature discs. Includes two disc dies and full size bolster. Has automatic stop for each revolution. Has not been used over six months. Also have for sale cheap new 60 light compound wound dynamos and 5 h. p. motors. **Geo. D. Whitcomb Co.,** 86 to 90 East Ohio St., Chicago.

WANTED.

A position as electrician, competent to take entire charge of plant, engines and boilers. Have had fifteen years' experience in electric lighting, and have had charge of plants for twelve years. Can refer to present and past employers in regard to experience and reliability. Address "P," care of WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

Competent electric light man to buy my stock, valued at $15,000, and take my position as superintendent of large Electric Light Co. which I am obliged to leave owing to ill health. Paying stock and good position. Address "X," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

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A first-class electrician and engineer desires a position to take charge of an electric light plant. Best of references, and wages very moderate. Address "E 4," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

Small plating dynamo of first-class make; must be perfect and cheap. Also offers of accessories or complete outfit for nickel. Address "Electro," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

We desire a good agent in each state to handle our "Dental and Surgical Lamps." Address all correspondence to the **PACIFIC ELECTRIC CO.,** La Crosse, Wis.

WANTED.

Portable ammeter. State capacity, Weston preferred. Also one 125 and one 150 light dynamo in good condition.

Scott Bros. Electric Co.,
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WANTED.

ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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531 Delaware, KANSAS CITY, MO.

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Westinghouse **TWO-PHASE MOTORS,** latest type. One 7½ and one 15 H. P., 200 volt., 7,200 alternations. Used short time. Splendid condition, guaranteed. Address **MOTOR,** care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

COLOR YOUR LAMPS 1 CENT EACH
WEBSTER CHEMICAL CO.
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Incandescent Lamp Supporters.

Instant placement and fixture of lamp in any desired position, with no attention to fastenings. Adapted to every requirement from library to workshop. Send for catalogue C.

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If you have any **Old Copper Wire** of any description to dispose of, it will pay you to communicate with us, as we are at all times in the market for any quantity of **Scrap Copper Wire,** at the highest market values. We pay cash and send prompt returns. We are also supplying the electrical trade with our high grade **Babbitt, Cotton Waste, Solder, Etc.** Please communicate with us.

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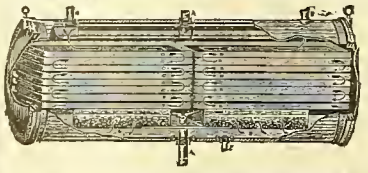
Stilwell's Patent LIVE STEAM-FEED Water Purifier.



Removes all Impurities.

ENTIRELY PREVENTS SCALE IN STEAM BOILERS. Catalogue on Application.

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DAYTON, OHIO.

Risdon Iron & Locomotive Works, San Francisco, Cal., Pacific Coast Agent.

Write for Prices on LIVE CEDAR POLES —TO— Cyrus S. Hart, OCONTO, WIS.

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A large handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of fifteen cents in postage by P. S. EUSTIS, Gen'l Pass. Agent, C., B. & Q. R. R., Chicago, Ill.

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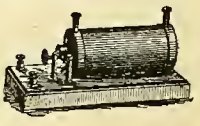
Ruhmkorff Induction Coils,

Telephone Coils, Experimental Work, Small Machinery, Binding Posts.



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FOR PRICES ON..... **CEDAR POSTS, POLES AND PILING**

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WHOLESALE PRODUCER OF ALL KINDS OF CEDAR PRODUCTS.

WHITE CEDAR POLES And STREET CAR TIES.

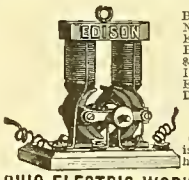
— Wholesale Producers.

PERRIZO & SONS, DAGGETT, MICH.

Ask the DeWitt Brown Cedar Co

MENOMINEE, MICH., for prices on WHITE CEDAR POLES.

WE UNDERSELL ALL!



Bicycle Electric Lights	$3.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
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88 Medical Batteries	3.95
Induction Coils	1.75
Electric Bells finest,	.25
Dry Batteries Best,	.25

Discount to Dealers.

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OF THE

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FOR SALE,

From Vol. I. to Vol. XV.

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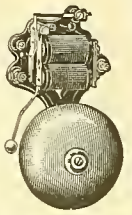

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—AND—

PUSH BUTTONS.

Exclusive Features.

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MANUFACTURERS,
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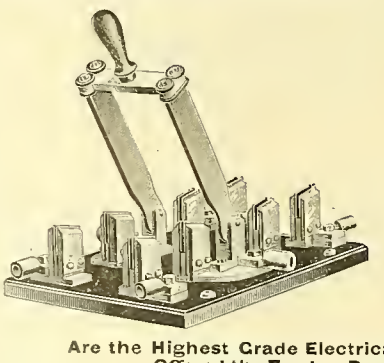

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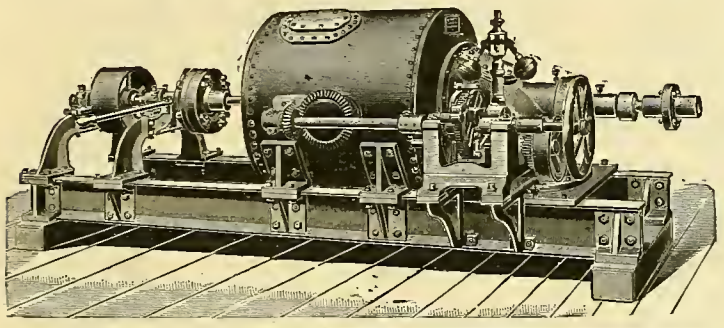
Are the Highest Grade Electrical Goods of Their Class Ever Offered the Trade. Don't Buy Poor Goods. Write for Prices.

W. S. HILL ELECTRIC COMPANY,

NEW BEDFORD, MASS.

BOSTON, 141 Franklin St. CHICAGO, Central Electric Company.
NEW YORK, Machado & Roller. SAN FRANCISCO, Abner Doble Co.

Victor Turbine Water Wheel.



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The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

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By W. H. WAKEMAN.

Price 75 Cents.

80 pages, 14 illustrations, bound in cloth.

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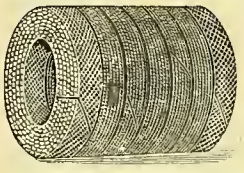

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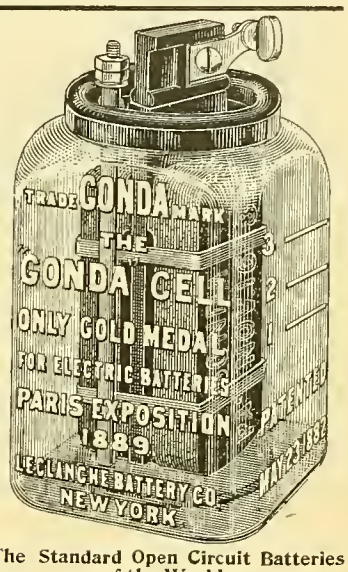

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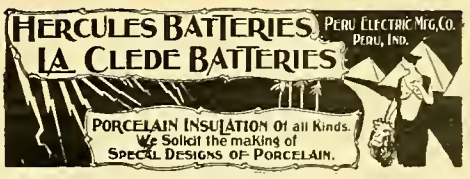

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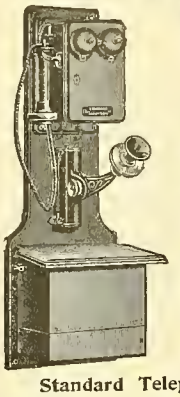

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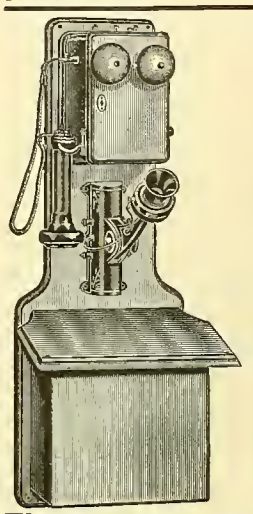

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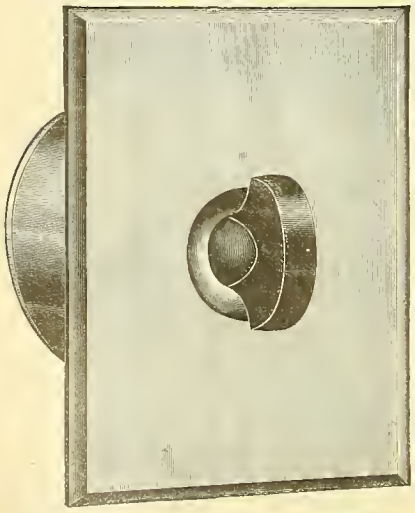

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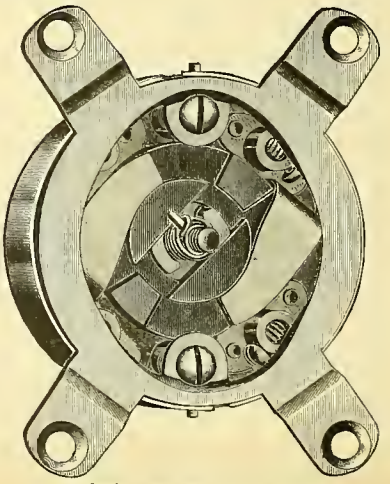

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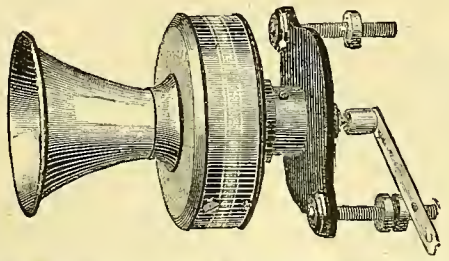

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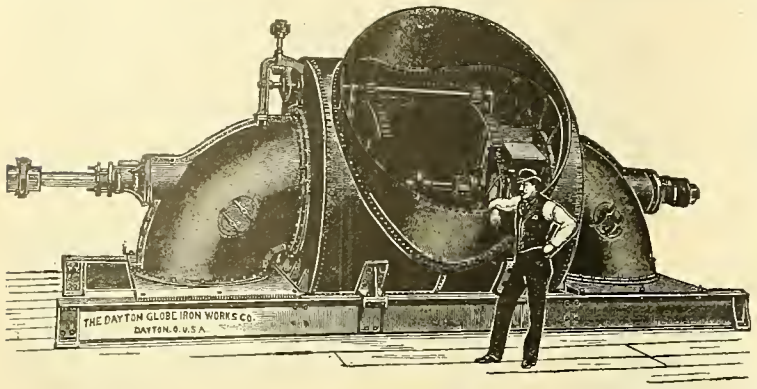

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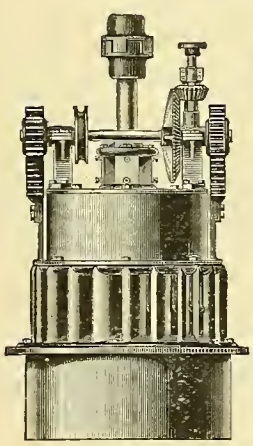

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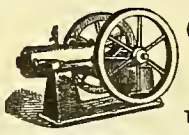

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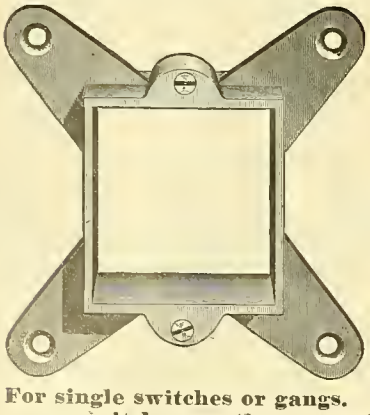

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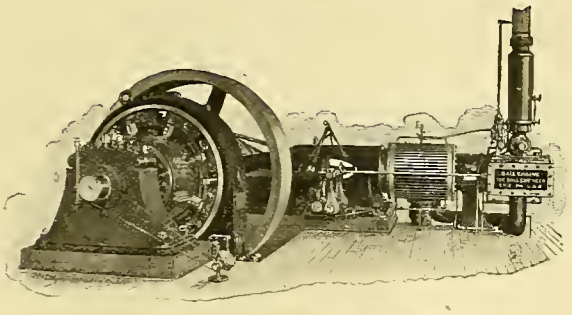

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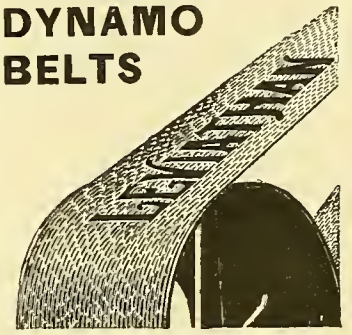

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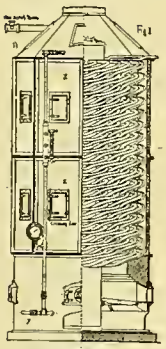

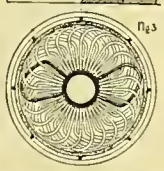

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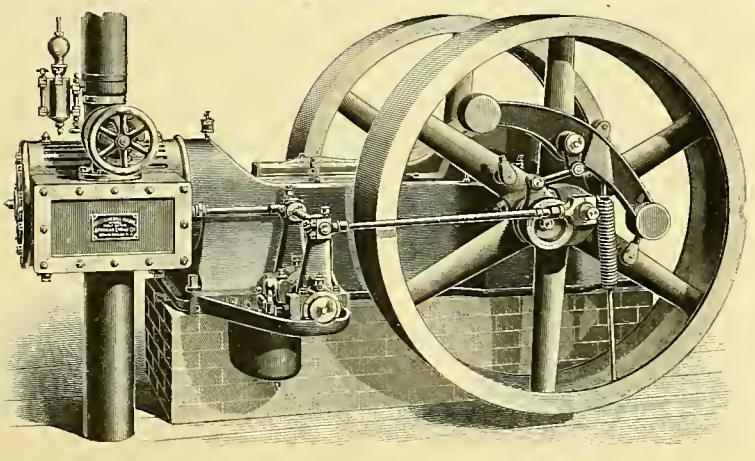

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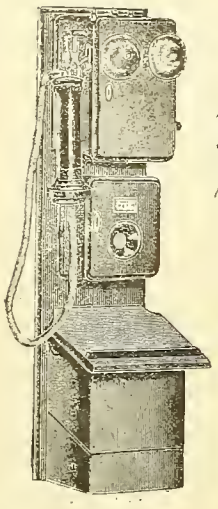

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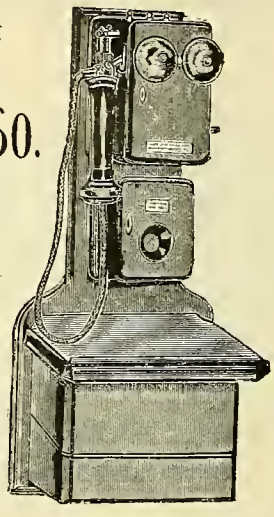

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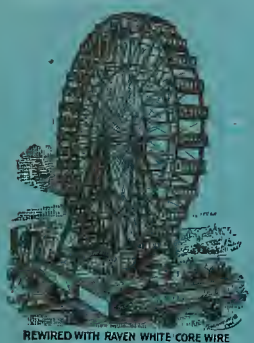
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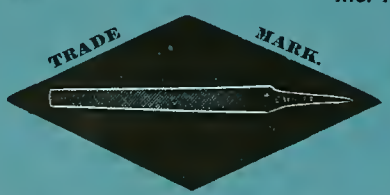

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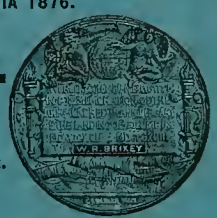

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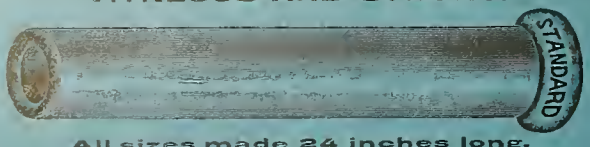
JULIAN SCHOLL & CO., - 126 Liberty St., N. Y. City.
THE REYNOLDS-LABOR & CO., 41 No. 10 St., Phila.
SCRANTON SUPPLY & MACH'Y CO., - Scranton, Pa.
THOS. K. CAREY & BRO., CO. 26 Light St., Baltimore, Md.

VITREOUS AND STRONG.



All sizes made 24 inches long.

Great Reduction in Prices of Wiring Tubes, Insulators, Cleats, Etc., HAVING EQUIPPED OUR FACTORY WITH NEW AND IMPROVED MACHINERY. . . . . .

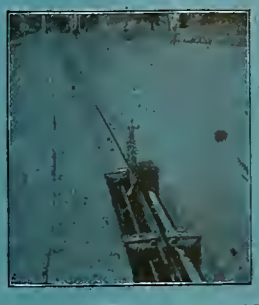
For sale by all leading supply dealers. Write for prices.

The Akron Insulator & Marble Co., Akron, O., U. S. A.

THE K. A. K. CONDUIT SYSTEM.

Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.

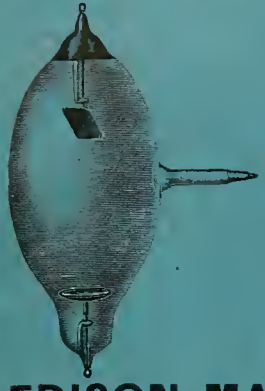


Practical in Operation.

SEND FOR FULL PARTICULARS.

KROTZ, ALLEN & KELLY, SPRINGFIELD, OHIO.

THE ONLY GENUINE EDISON



X-RAY APPARATUS AND FOCUS TUBES

ARE MANUFACTURED BY

THE EDISON MANUFACTURING COMPANY.

Special Focus Tubes for Battery X-Ray Sets.
Special Focus Tubes for Direct Current X-Ray Sets.
Special Focus Tubes for Static Machine Work.
3, 4, 6, 8, 10 and 12-inch X-Ray Sets for Battery and 120-Volt Direct Current.

WRITE FOR NEW CATALOGUE.

ALL OUR FOCUS TUBES ARE MANUFACTURED AT THE

EDISON LABORATORY.

EDISON MANUFACTURING CO.,
110 EAST 23d STREET, NEW YORK.

SEARCHLIGHTS

—FOR—

RIVER, LAKE AND MARINE STEAMERS,

From 2,000 to 10,000 C. P.

LATEST AND MOST APPROVED CONSTRUCTION.

Improved Pilot House Steering Gear.

Send for Catalogue "A."

CARLISLE & FINCH,
832 WEST 6TH STREET,
CINCINNATI, OHIO.

THE CALIFORNIA ASPHALT CO. OF NEW YORK — ALCATRAZ ELECTRICAL COMPOUND

Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.
COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

SAMPLE UPON APPLICATION.

C. P. WILLIAMS, Sole Agent U. S. A. 39-41 Cortlandt St., New York City.

WHEN BUYING DYNAMOS AND MOTORS,

WE ASSUME YOU WANT THE BEST.

WRITE US.

KEYSTONE ELECTRIC CO.,

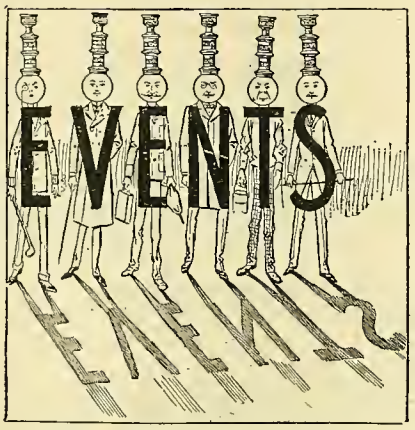
MAIN OFFICE AND WORKS:

1221 WEST TWELFTH STREET, ERIE, PA.

CHICAGO OFFICE, MARQUETTE BUILDING.

AGENCIES IN OTHER CITIES.

BOSTON OFFICE, 41 FEDERAL STREET.



"Coming Events Cast their Shadows Before."

The new "Pioneer" Enclosed Arc Lamp, STYLE "B is an *event* in the electrical world. Its *coming* cast a shadow on cheap competition. It is rich and elegant in exterior, and carefully constructed and tested.

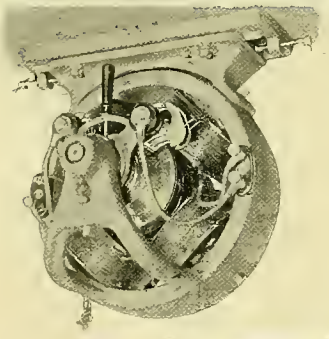
It presents the acme of enclosed arc lighting.

PIONEERS IN ENCLOSED ARC LIGHTING — 150 HOURS

THE ELECTRIC ARC LIGHT CO.

LOUIS B. MARKS, M.M.E., CHIEF ELECTRICIAN.

687 & 689 Broadway, NEW YORK.



WRITE FOR INFORMATION.

DYNAMOS,

15 to 1,000 Lights.

MOTORS,

½ to 50 H. P. ANY VOLTAGE.

Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

The Ahlm-Edwards Electric Co.,

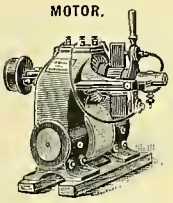
MEDINA, OHIO.

CLYMER & HEILMAN,

Manufacturing Electricians,

READING, PA.

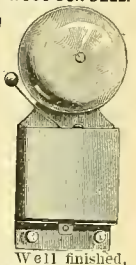
MOTOR.



First-class workmanship, all sizes and voltages, special price.

½ h. p., 110 volt, Reversible, **$9.50.**

WOOD BOX BELL.



Well finished, **$28** per 100. Send for sample dozen, **$3.40.** express prepaid for cash with order.

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

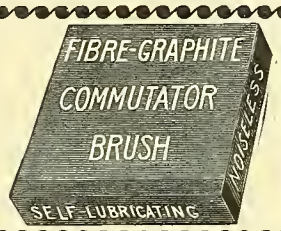
No Sparking Under Varying Load,
No Wear on the Commutator.

90% PURE GRAPHITE.

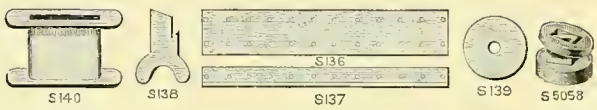
Holmes Fibre-Graphite Mfg. Co.,

Station Z, Philadelphia.

WRITE FOR PRICE LIST.



VULCABESTON CONTROLLER PARTS.



All Controllers are Insulated with Vulcabeston.

G. E. 800 and Westinghouse Commutator Rings, Brush Holder Bushings and Field Spools.

SEND FOR PRICE LIST.

Moulded Mica Trolley Insulating Materials, Frogs, Crossings, Tree Insulators, Weatherproof Sockets, etc.

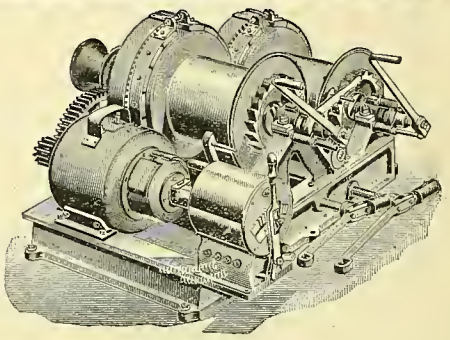
H. W. JOHNS MFG. CO.,

240-242 Randolph St., Chicago, Ill.

Gen. Elec. Co. NEW YORK. PHILADELPHIA. BOSTON.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

CHICAGO OFFICE: Metropolitan Elec. Co., 186-188 Fifth Ave.
NEW YORK OFFICE: 136 Liberty Street.
BRANCH FACTORY: Hamilton, Canada.

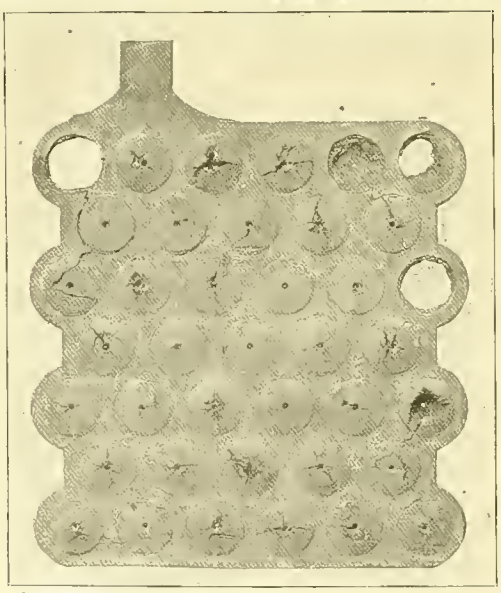
PARTRICK & CARTER CO. 125 SOUTH SECOND ST. PHILADELPHIA

MANUFACTURE GENERAL ELECTRIC SUPPLIES

ANNUNCIATORS
BURGLAR & FIRE ALARMS
SIGNAL GONGS-BELLS etc.

DO YOU RECOGNIZE THE PLATE?

The "American" Cells are absolutely non-infringing. Protection fully guaranteed to purchasers.



Do you remember the claims made for it?

Standard Heat Controller Co.
Manufacturers of
Improved and Superior
Apparatus for Automatic Control of Temperature.
211 First National Bank Building
Chicago: Feb. 24, 1897.

American Battery Co.,
42 Quincy St.,
City.

Gentlemen:-

In reply to yours of the 22nd inst. would say: Out of fifty cells bought of the "Electric Storage Battery Co." only four gave results claimed for them. They were never discharged above the normal rate and always had the best of attention. After three months of service, the positive plates gave out entirely and had to be thrown in the scrap pile.

We take pleasure in stating that after fifteen months service, the "American" cells purchased of you have given entire satisfaction and have not cost one cent for repairs.

Yours &c.

Standard Heat Controller Co.,

P B Walsh Electrician

The original, from which cut was made, is a plate, taken from a "Chloride" cell used by "Standard Heat Controller Co." less than three months.
ATTENTION is called to appearance of the plugs of "active material" still in the plate. What can you expect after a year's service?

NOTE! The American Battery Co. will furnish free of charge all renewals required for any "American" cells sold by us, since November, 1895, where such are necessary through deterioration of plates in service. This offer to hold good until May 1, 1897.

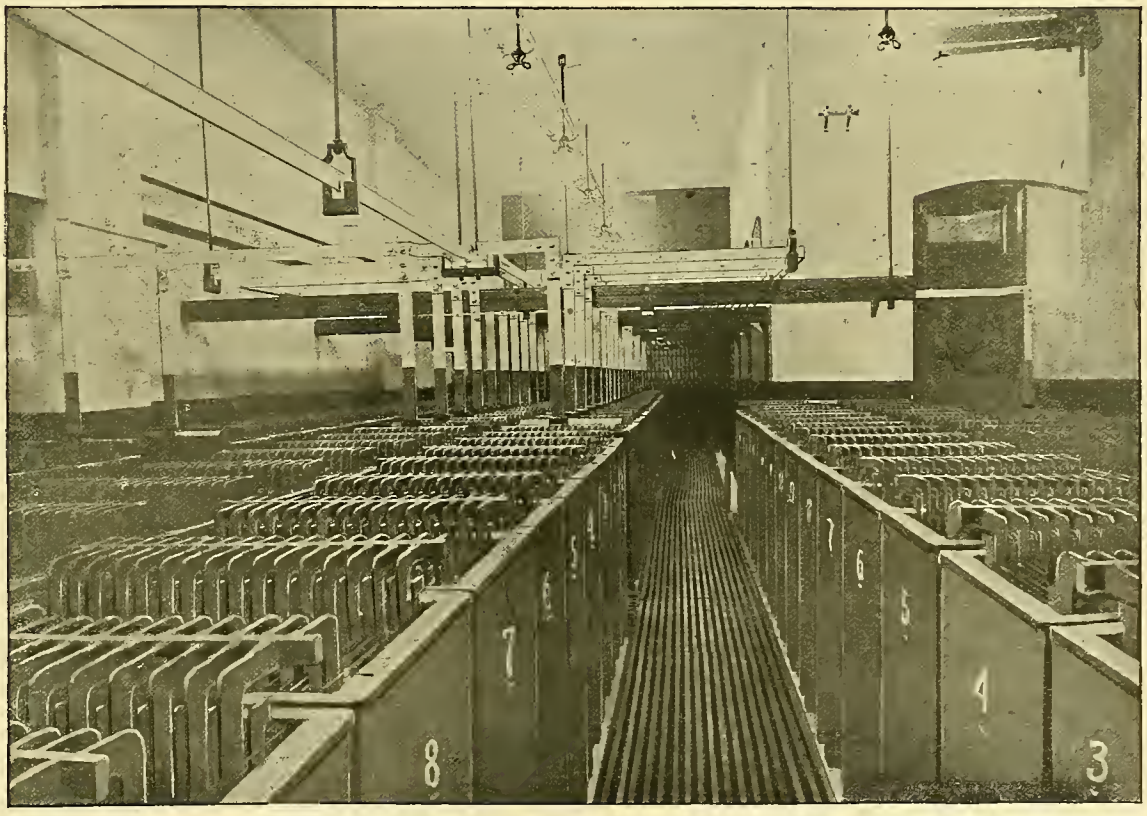
AMERICAN BATTERY CO., 42 W. Quincy St., Chicago, Ill.

TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

The largest Independent Storage Battery Station in America is that just put into operation by The New York Edison Illuminating Co. in the Bowling Green Building. The station contains no generators whatever and is fed entirely by feeders a mile long. The battery consists of

"CHLORIDE ACCUMULATORS."

REGISTERED SEPTEMBER 11, 1894.



Chloride Accumulators, 8,000 ampere hours at 150 volts, in the Bowling Green, New York, Storage Battery Station.

The Electric Storage Battery Company,

DREXEL BUILDING, PHILADELPHIA, PA.

BRANCH OFFICES: 66 Broadway, New York; 1543 Marquette Building, Chicago, Ill.; 215 N. Calvert St., Baltimore, Md.; 222 Market St., San Francisco, Cal.; 92 State St., Boston, Mass.

"I consider the apparatus the best yet designed for practical application, and it will undoubtedly prove an invaluable aid to surgery."

Dr. C. B. HERRICK,
Surgeon of the Fitchburg, and Del. & Hudson R. R. Co.

PERFECTED BY

L. E. Knott Apparatus Co.,

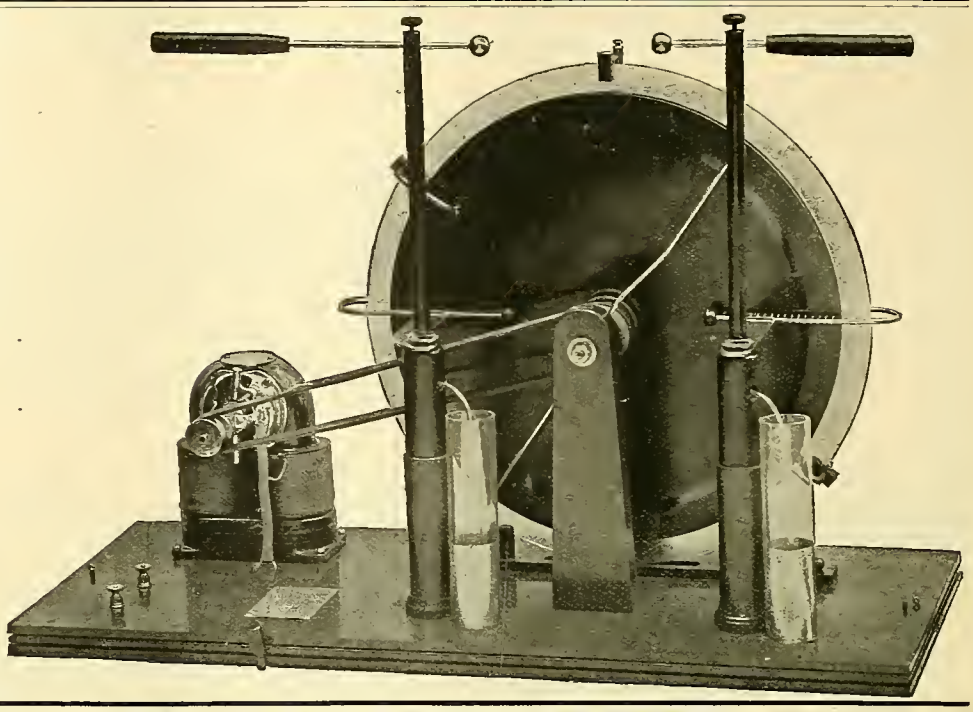
14 ASHBURTON PLACE,

BOSTON, MASS.

Operated by
Hand Power, Electric Motor, Water Motor, } Direct or Alternate Current.

Speed 2,500 Revolutions per Minute.
Continuous Discharge.
Perfect Adjustment.

Crookes Tubes. High Frequency Coils. Fluoroscopes.



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Accumulators.
American Battery Co.
Electric Storage Battery Co.

Annunciators.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Arc Lamps.
Bullock Elec. Mfg. Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Diehl Mfg Co.
Electric Arc Light Co.
Ft. Wayne Elec. Corporation.
Keystone Electric Co.
Manhattan Gen'l Cons. Co.
Perkins Elec. Switch Mfg. Co.
Puritan Electric Co.
Standard Therm. & Elec. Co.
Westinghouse El. & Mfg. Co.

Arc Light Cord.
Samson Cordage Wks.

Assayers.
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Batteries and Jars.
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Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Edison Mfg. Co.
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Electric Storage Battery Co.
Genor & Colburn.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Midland Electric Co.
Ohio Electric Works.
Peru Elec. Mfg. Co.
Western Electric Co.

Bells.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Ohio Electric Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Jewell Belting Co.
Main Belting Co.
Shultz Belting Co.

Boilers.
Clonbrock Steam Boiler Co.
Racine Hardware Co.
Weston Engine Co.

Books, Electrical.
Electrician Publishing Co.

Bronze.
Besly & Co., Chas. H.
Phosphor BronzeSm.Co.,Ltd.

Brushes.
Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
McKeague, J. B.
Partridge Carbon Co.
Wirt. Chas.

Burglar Alarms.
Commercial El. Supply Co.
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.
Western Electric Co.

Cables (See Insulated Wires.)

Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Brixey, W. R.
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Eastern Electric Cable Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.
Western Electric Co.

Carbons, Points & Plates.
Chicago Edison Co.
Chicago General Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Standard Paint Co.
Western Electric Co.

Cars.
Brill Co., J. G.

Coloring for Inc. Lamps.
Webster Chemical Co.

Compound.
California Asphalt Co.
Commercial El. Supply Co.
Electric Appliance Co.
Johns Mfg. Co., H. W.
McLennan & Co., K.
Okonite Co.
Standard Paint Co.

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Akron Ins. & Marble Co.
Armorite Interior Cond. Co.
Camp Co., H. B.
Commercial El. Supply Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.

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Bullock Elec. Mfg. Co.
Chicago Edison Co.
Davis, L. W.
Electrical Exchange, The.
Ft. Wayne Elec. Corporation.
Hodge, Walsh & Loring.
Keystone Electric Co.

Contractors and Electric Light Plants.
Ahlm-Edwards El. Co.
Arnold, B. J.
Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
Bullock Elec. Mfg. Co.
Card Electric Co.
Clymer & Heilman.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
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Standard Underground C. Co.
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Cordage.
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Edison Dec. & M. L. Dept.
Edison Mfg. Co.
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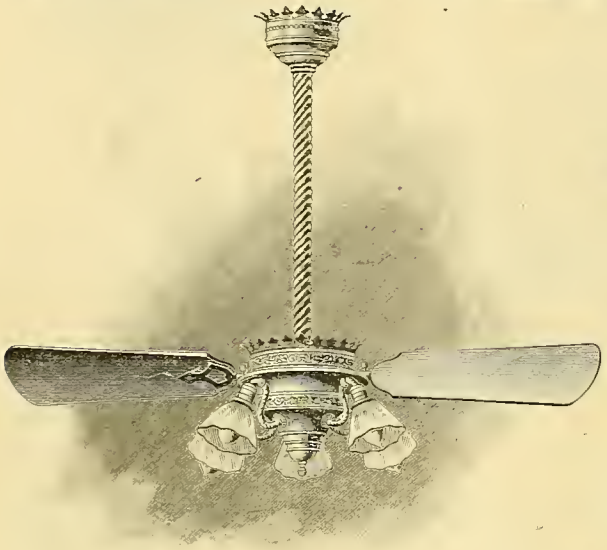

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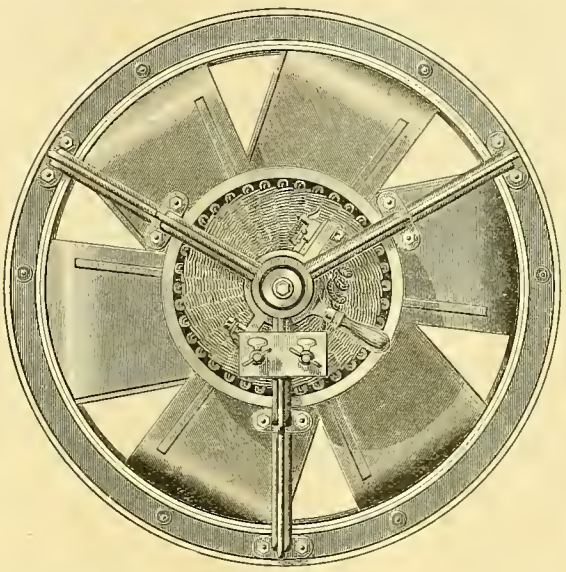

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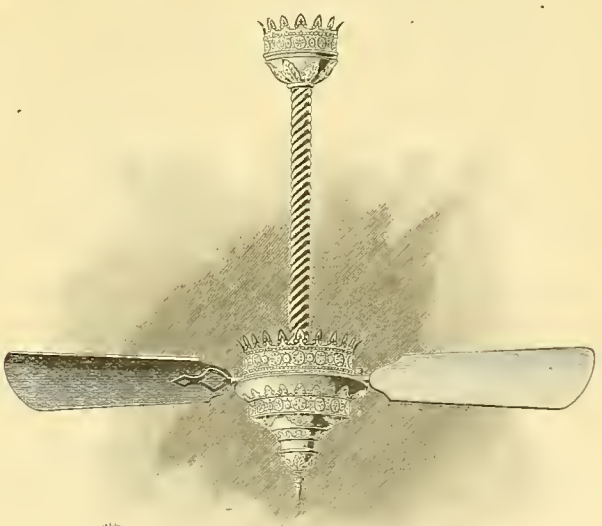

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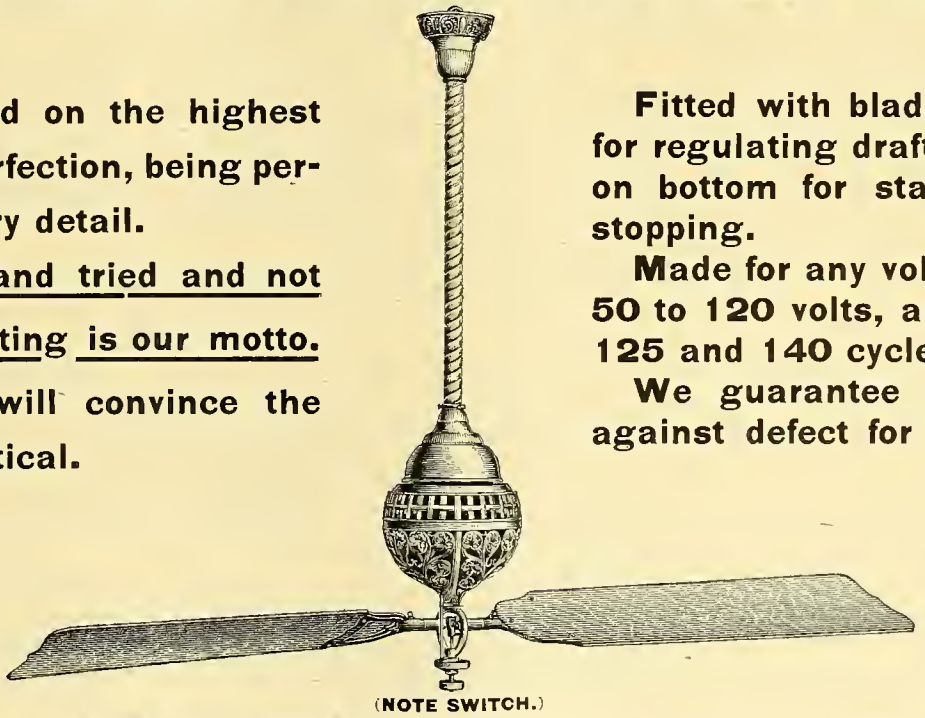

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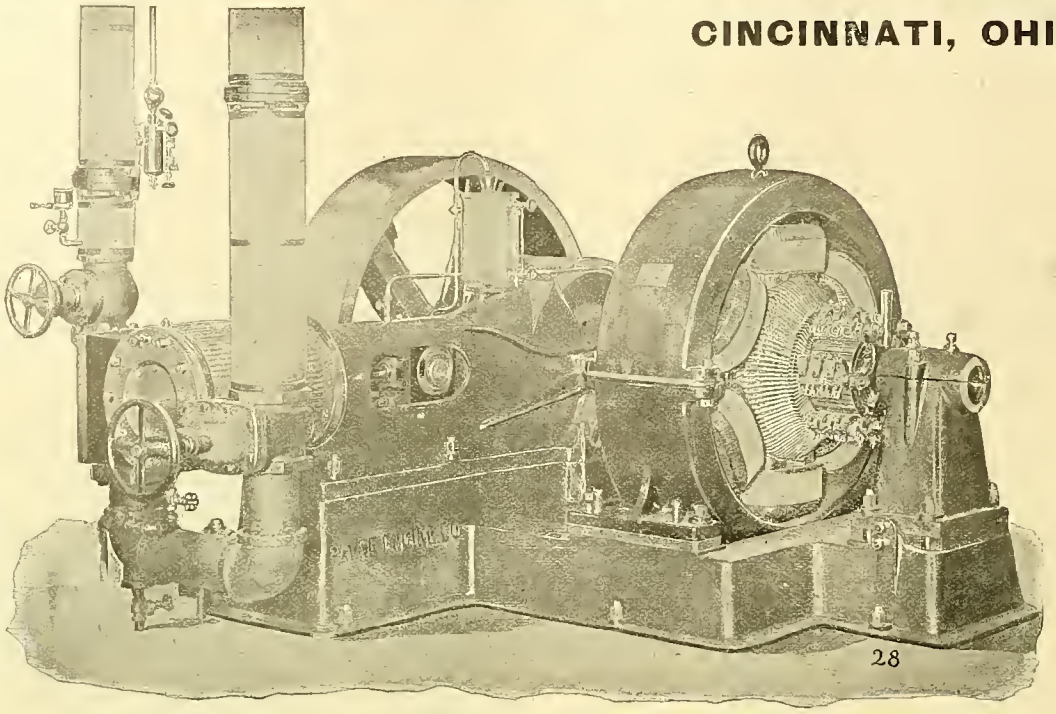

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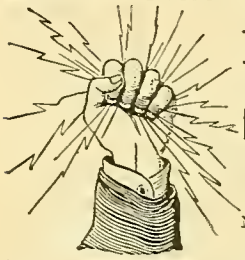

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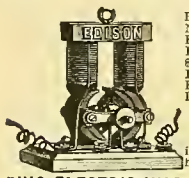

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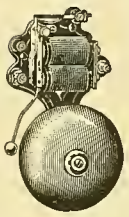

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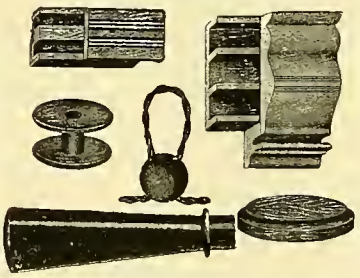

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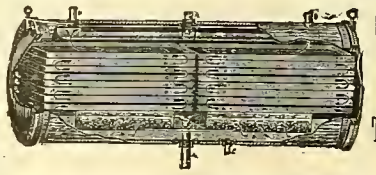

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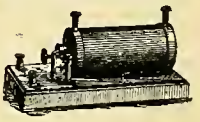

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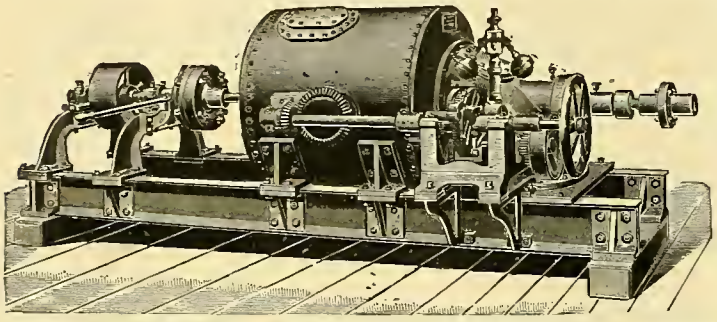

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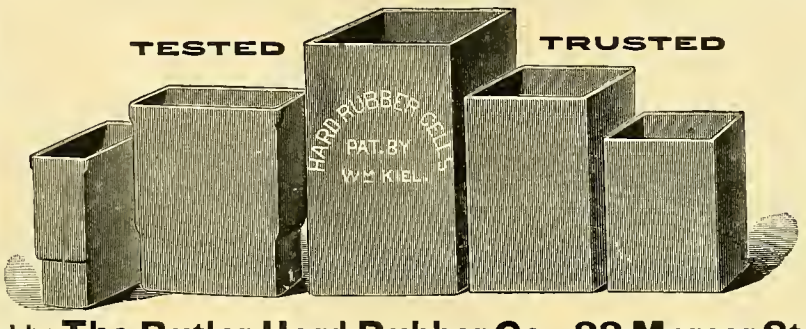

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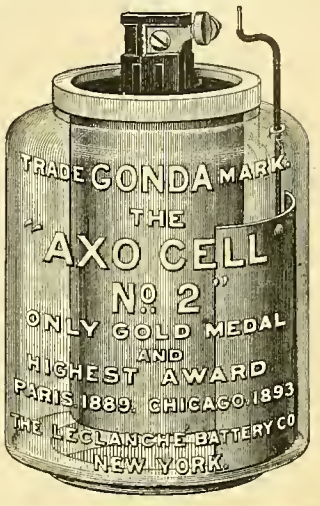

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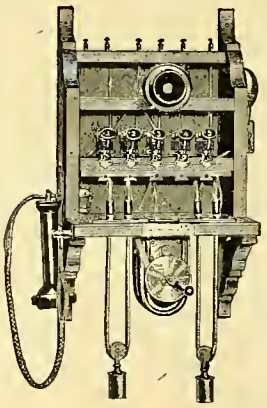

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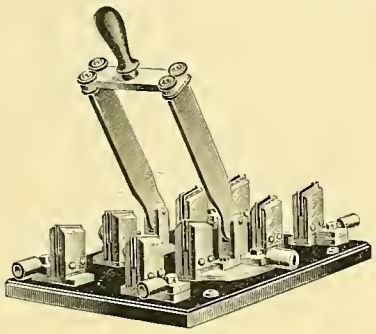

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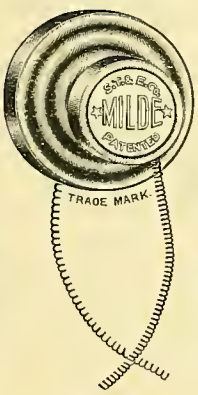

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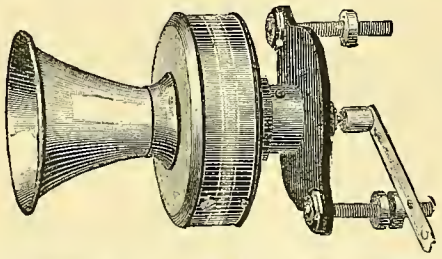

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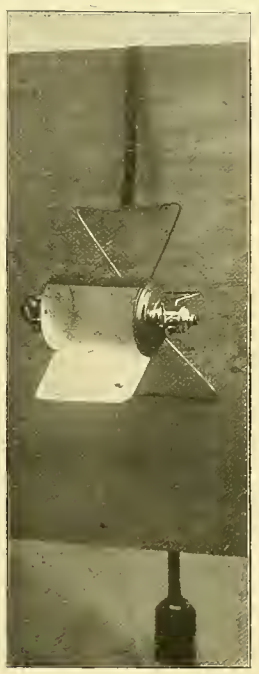

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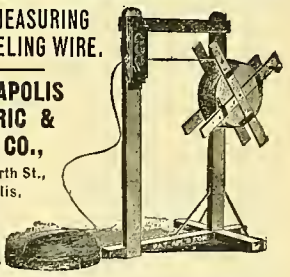

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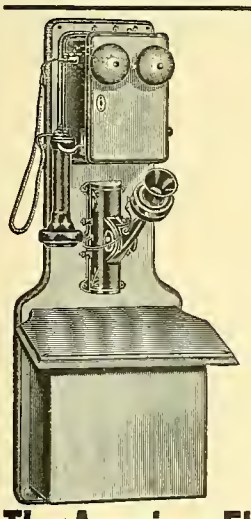

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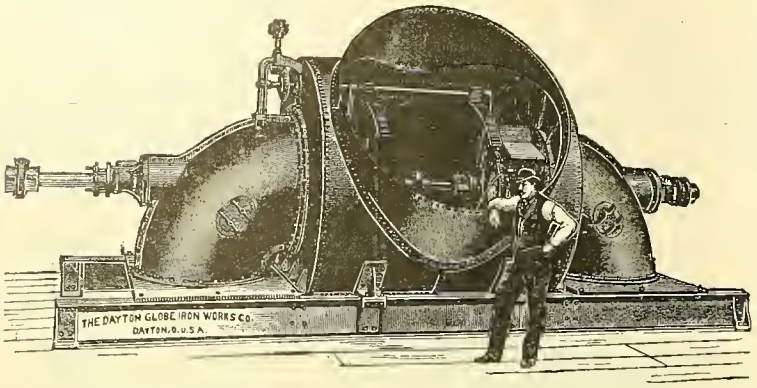

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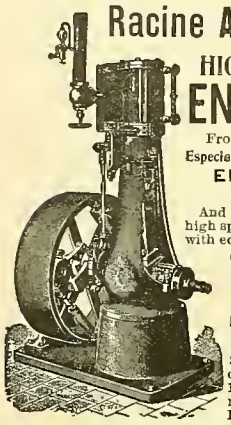

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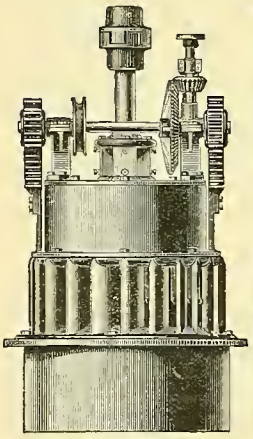

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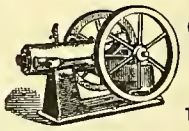

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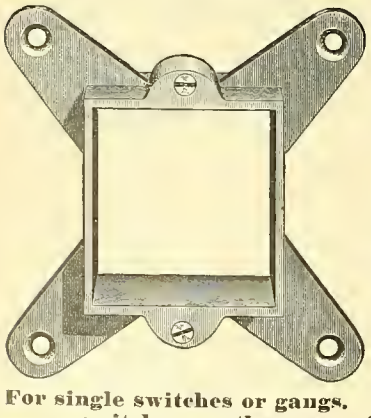

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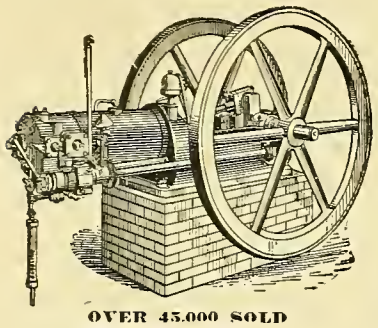

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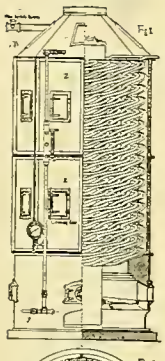

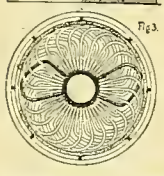

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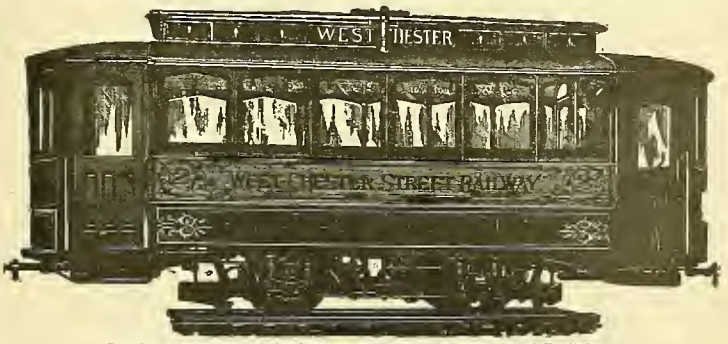

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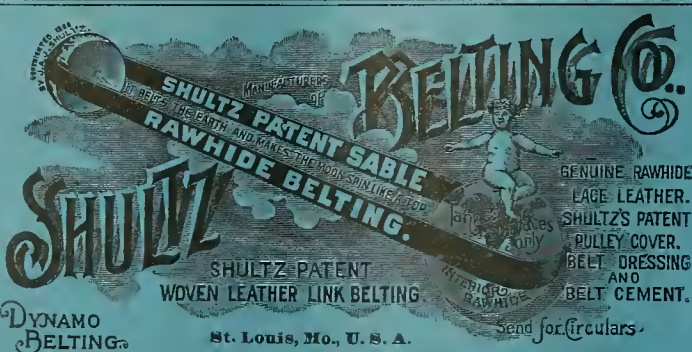

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Vol. XX. CHICAGO, MARCH 27, 1897. No. 13

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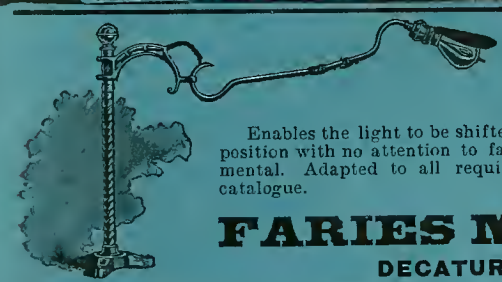

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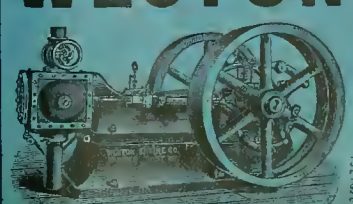

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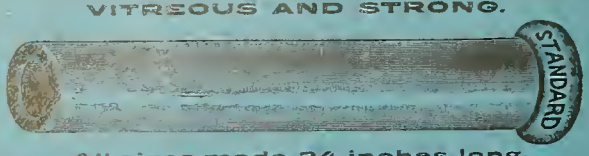

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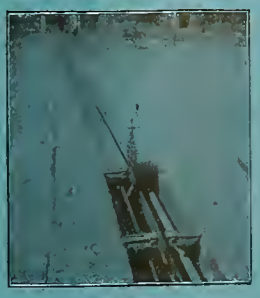

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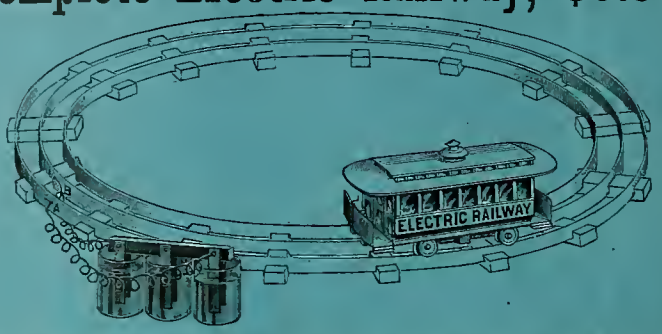

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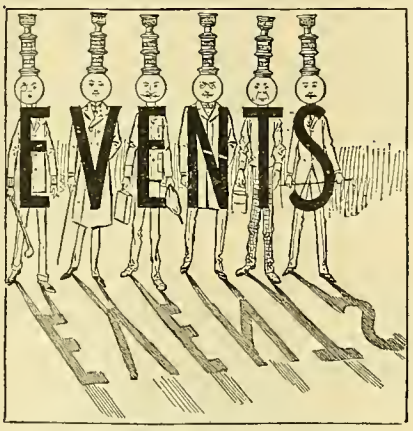

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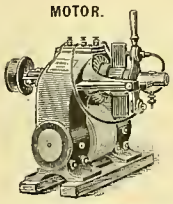

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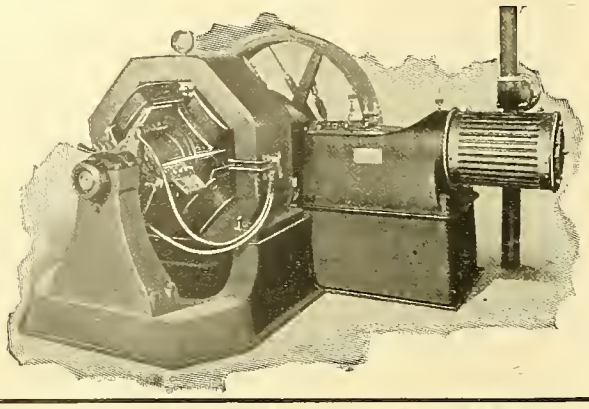
Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



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We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

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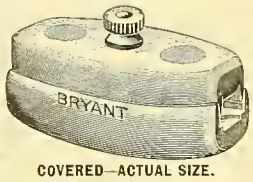
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.



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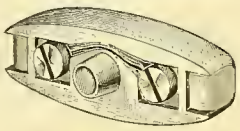

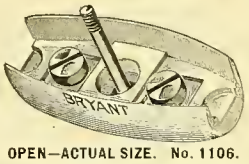

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ONE NUT ONLY.

Impossible to Short Circuit.
Fuse in Cap Not in Base.

Not necessary to disturb CONNECTING WIRES in replacing FUSE. Write your supply house for samples and price. If they cannot furnish, write us direct.

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Engineers and Contractors for Complete Subways.

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Incorporated 1892.

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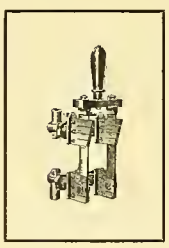
We manufacture a high grade Knife Switch for switchboard work. We call it the E Switch.



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We have in stock in our Chicago Store

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Sockets, Switches, Cut-Outs,
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Bells, Annunciators,
Batteries, Push Buttons,
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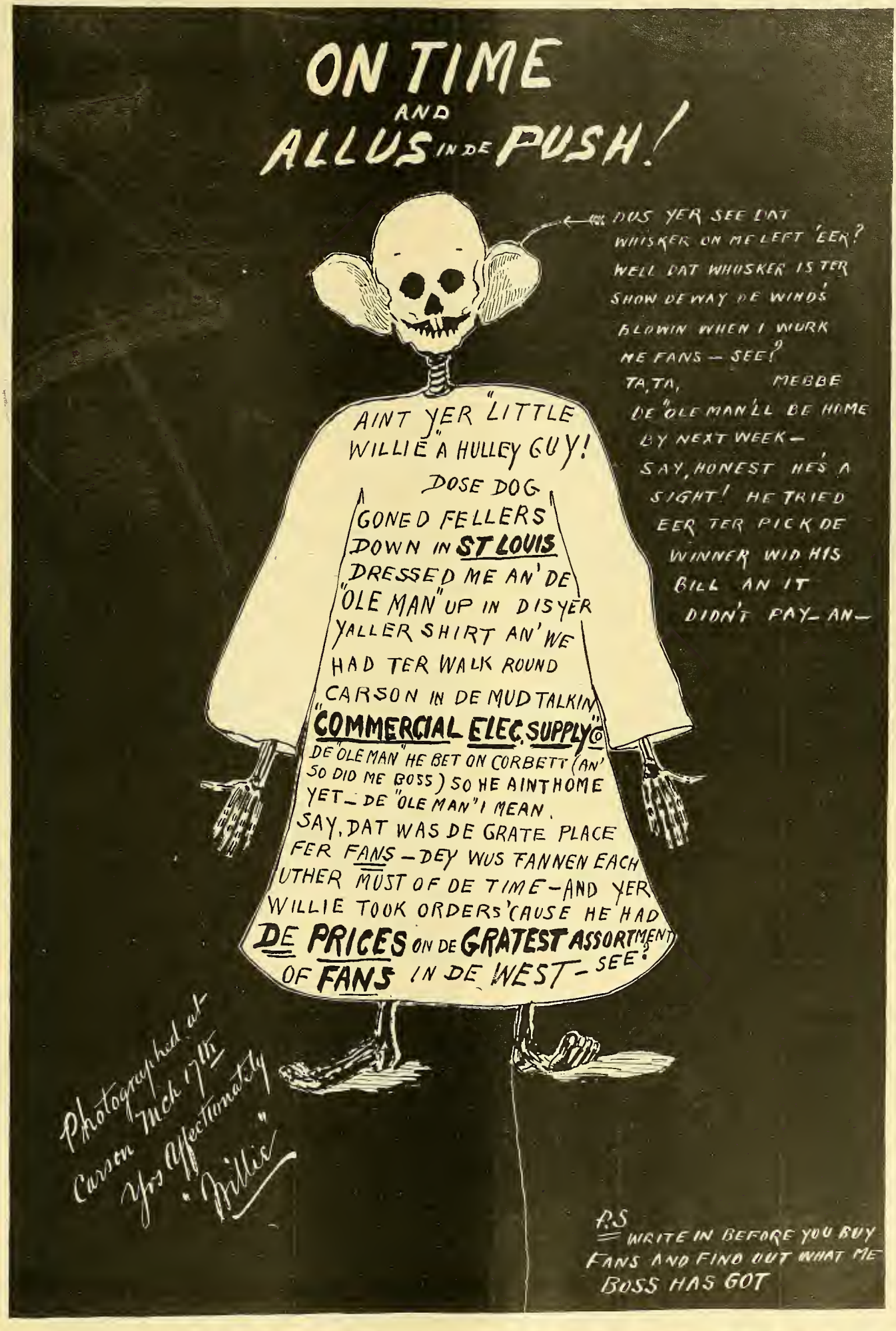
ON TIME
AND
ALLUS IN DE PUSH!
DOS YER SEE DAT WHISKER ON ME LEFT 'EER? WELL DAT WHUSKER IS TER SHOW DE WAY DE WINDS BLOWIN WHEN I WURK ME FANS — SEE? TA, TA, MEBBE DE "OLE MAN'LL BE HOME BY NEXT WEEK — SAY, HONEST HE'S A SIGHT! HE TRIED EER TER PICK DE WINNER WID HIS BILL AN IT DIDN'T PAY — AN —
AINT YER "LITTLE WILLIE" A HULLEY GUY!
DOSE DOG GONED FELLERS DOWN IN ST LOUIS DRESSED ME AN' DE "OLE MAN" UP IN DISYER YALLER SHIRT AN' WE HAD TER WALK ROUND CARSON IN DE MUD TALKIN "COMMERCIAL ELEC. SUPPLY" @ DE "OLE MAN" HE BET ON CORBETT (AN' SO DID ME BOSS) SO HE AINT HOME YET — DE "OLE MAN" I MEAN. SAY, DAT WAS DE GRATE PLACE FER FANS — DEY WUS FANNEN EACH UTHER MUST OF DE TIME — AND YER WILLIE TOOK ORDERS 'CAUSE HE HAD DE PRICES ON DE GRATEST ASSORTMENT OF FANS IN DE WEST — SEE?
Photographed at Carson Mch 17th
Yos Affectionately
"Willie"
P.S. WRITE IN BEFORE YOU BUY FANS AND FIND OUT WHAT ME BOSS HAS GOT

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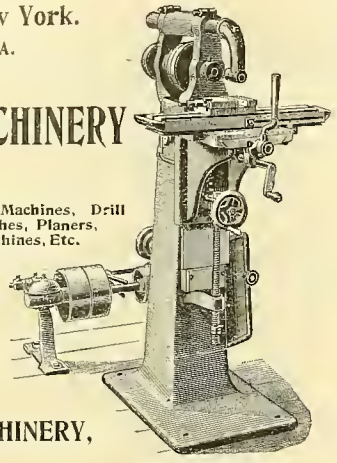

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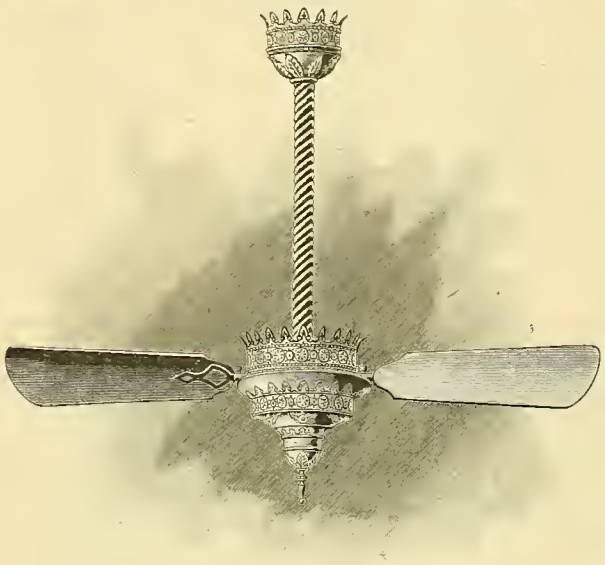

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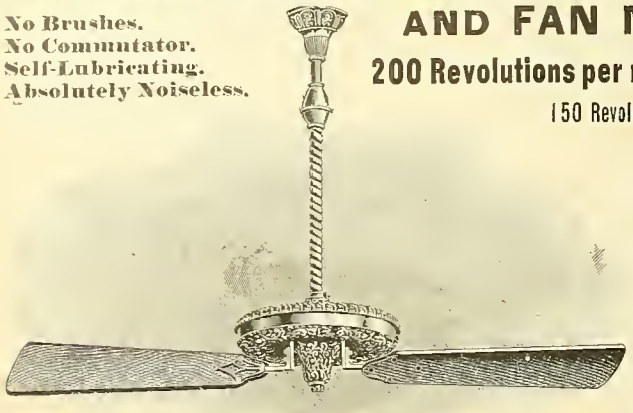

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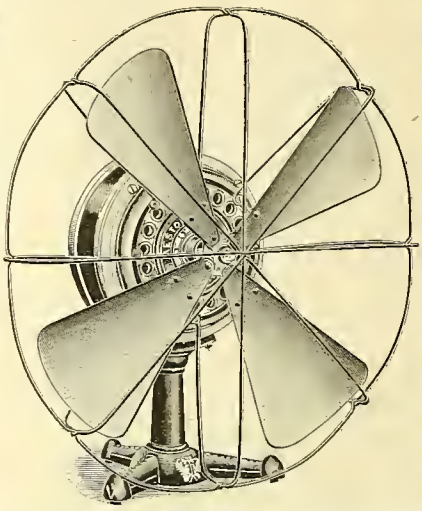

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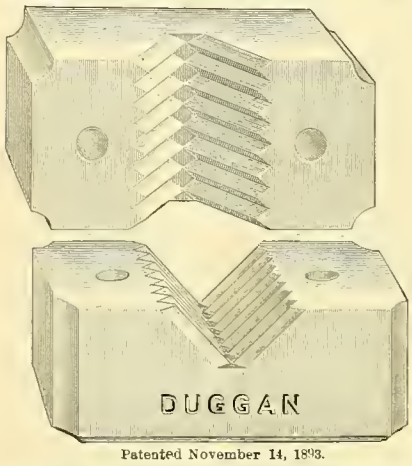

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They are corrugated and V-shaped groove.

They grip like a vise.

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They are made of the finest glazed porcelain. Ten of them used to one of any other make.

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Porcelain Specialties of all kinds.

THE 1897 TUERK ALTERNATING CEILING FAN

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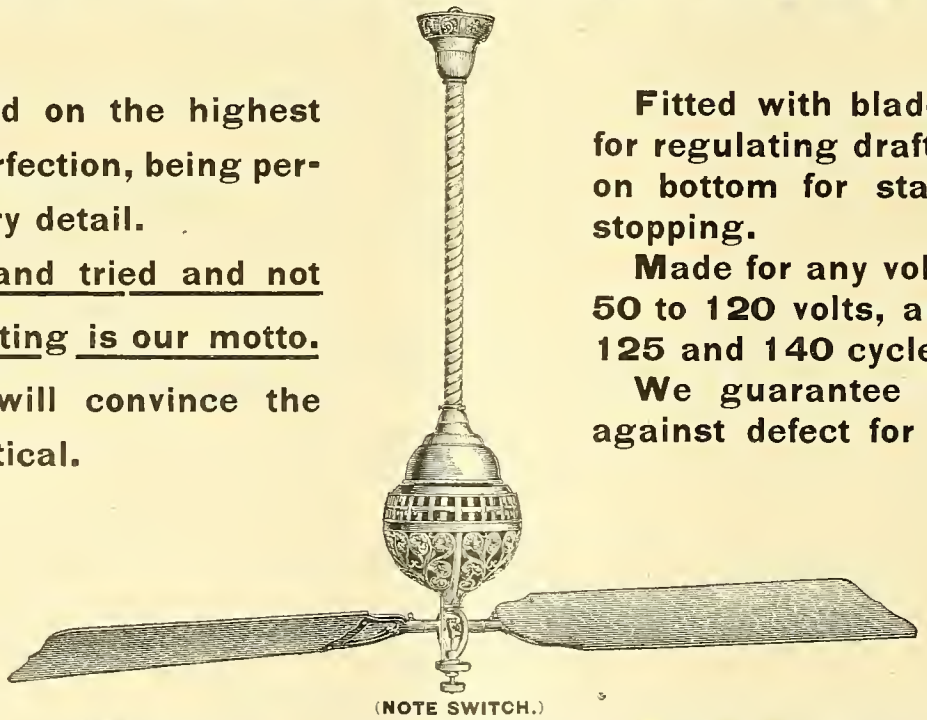
Tested and tried and not found wanting is our motto.

A trial will convince the most skeptical.



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Fitted with blade adjuster for regulating draft. Switch on bottom for starting and stopping.

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We guarantee our fans against defect for one year.

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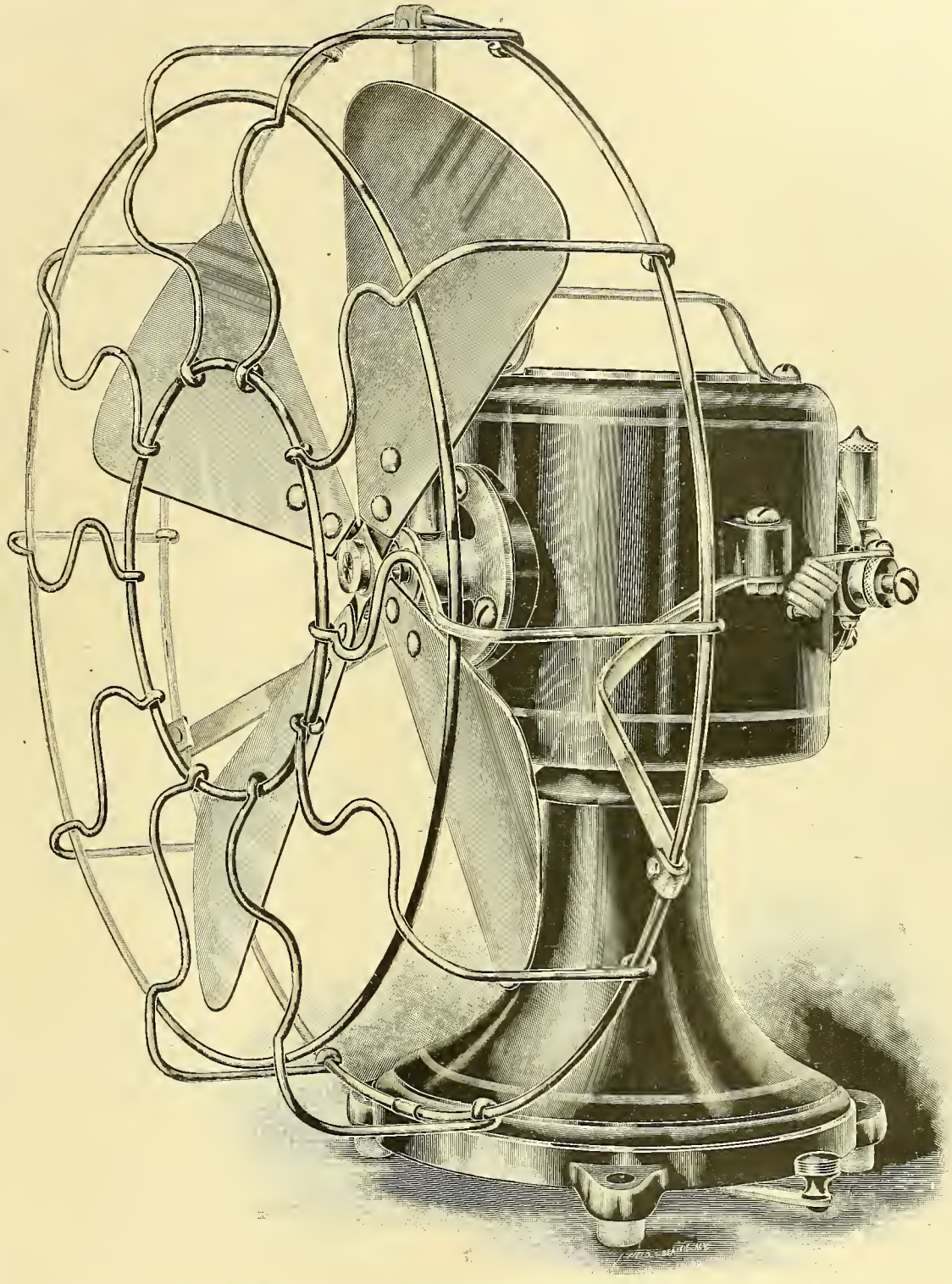

Motors Enameled in Any Color to Match Decorations Wherever Installed. No Extra Charge for Colors.

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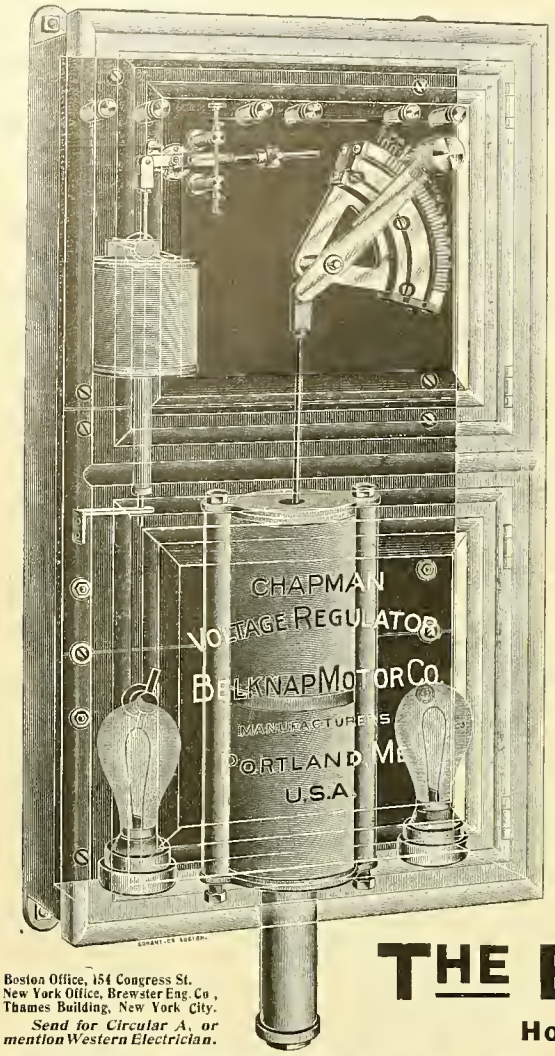

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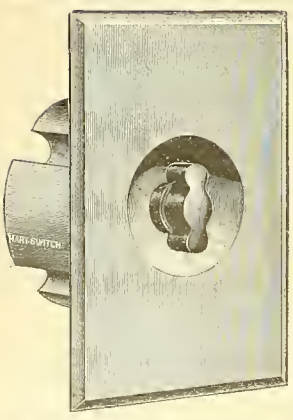

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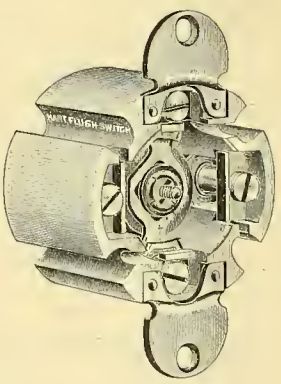

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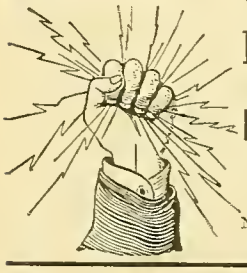

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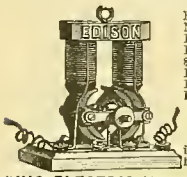

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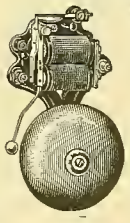

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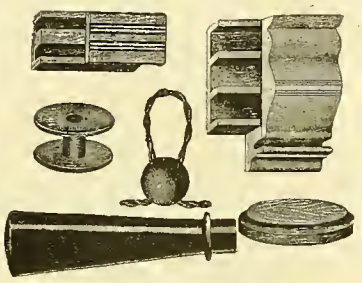

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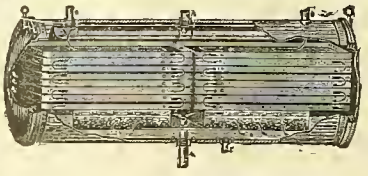

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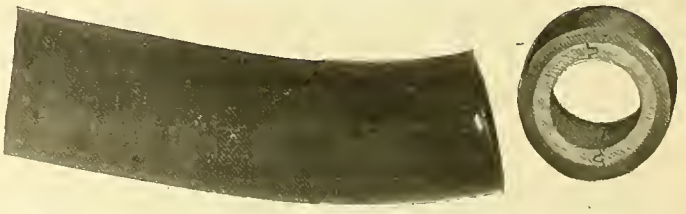

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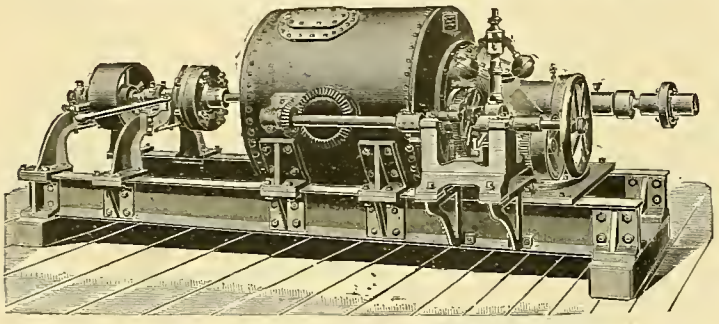

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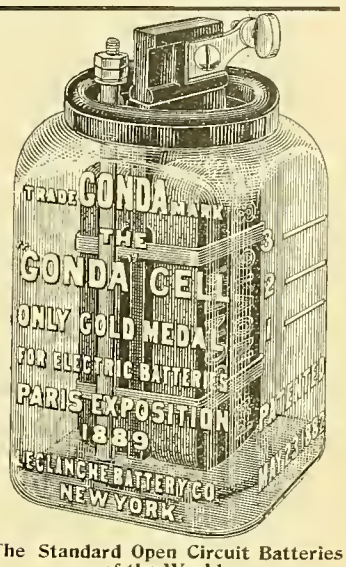

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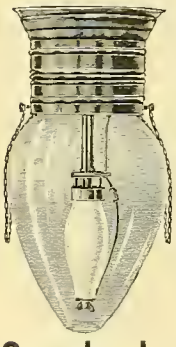

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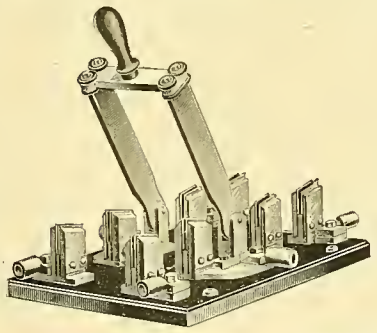

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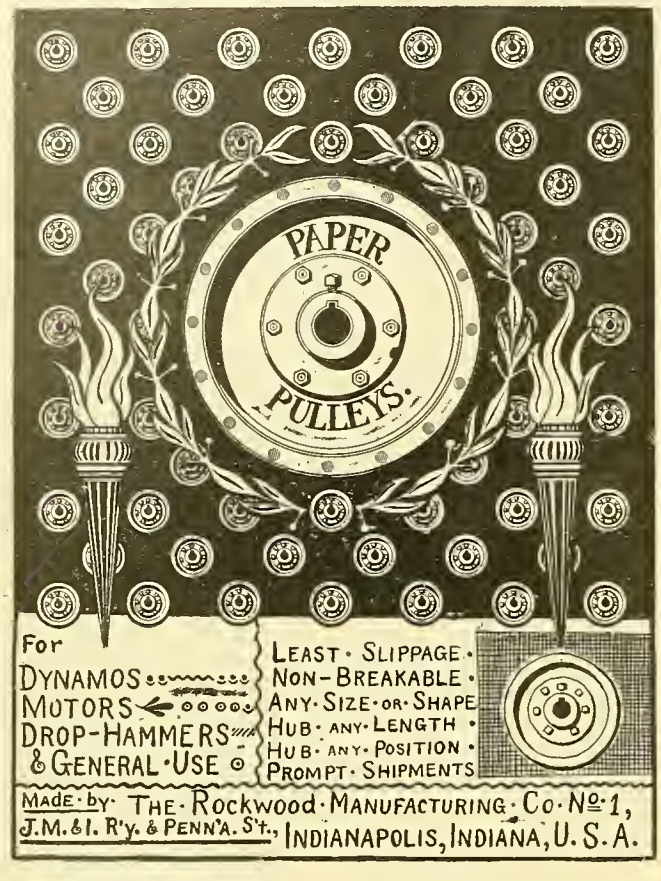

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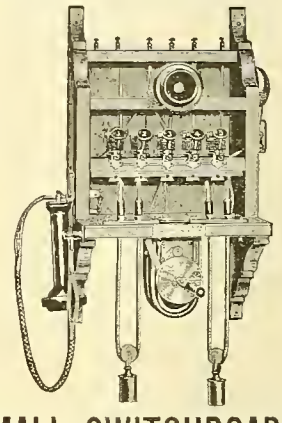

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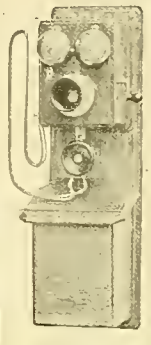

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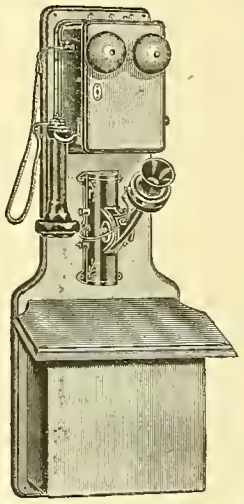

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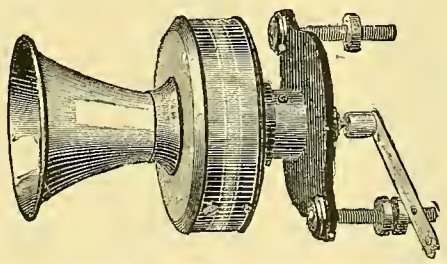

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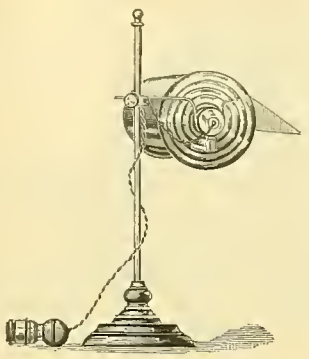

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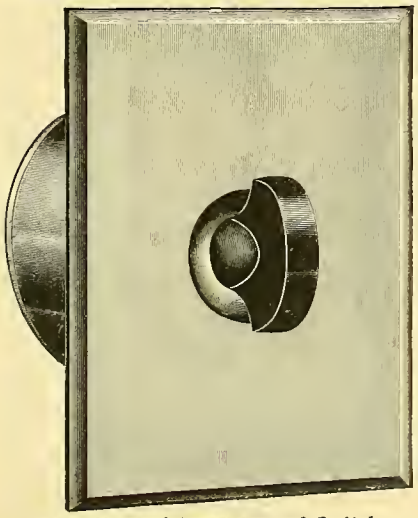

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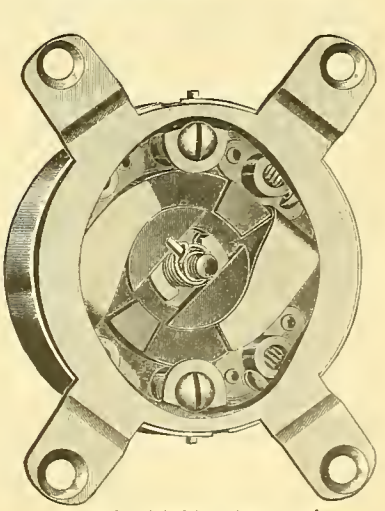

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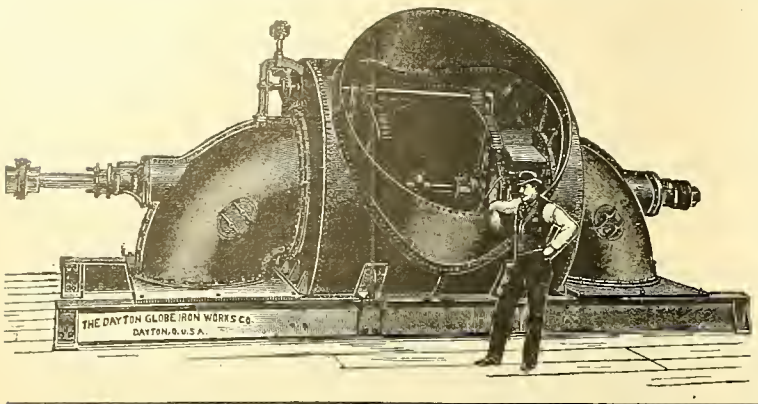

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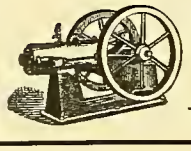

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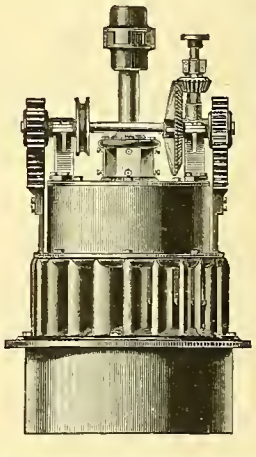

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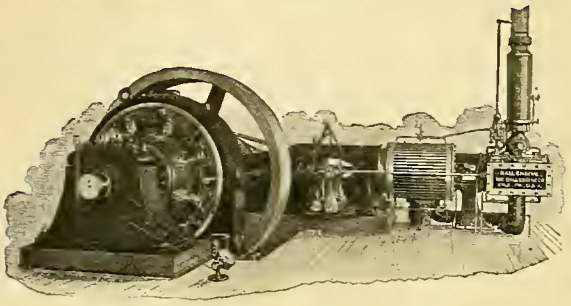

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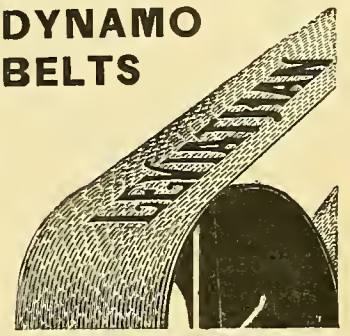

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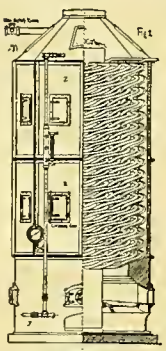

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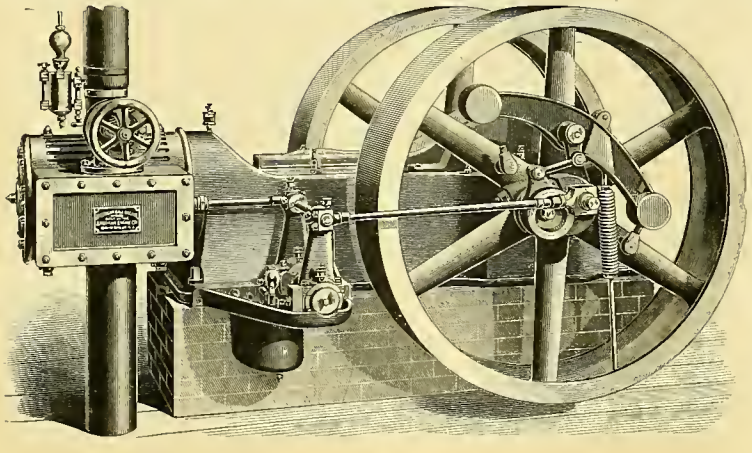

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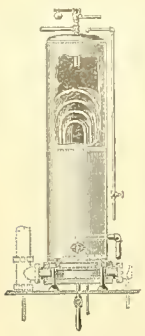

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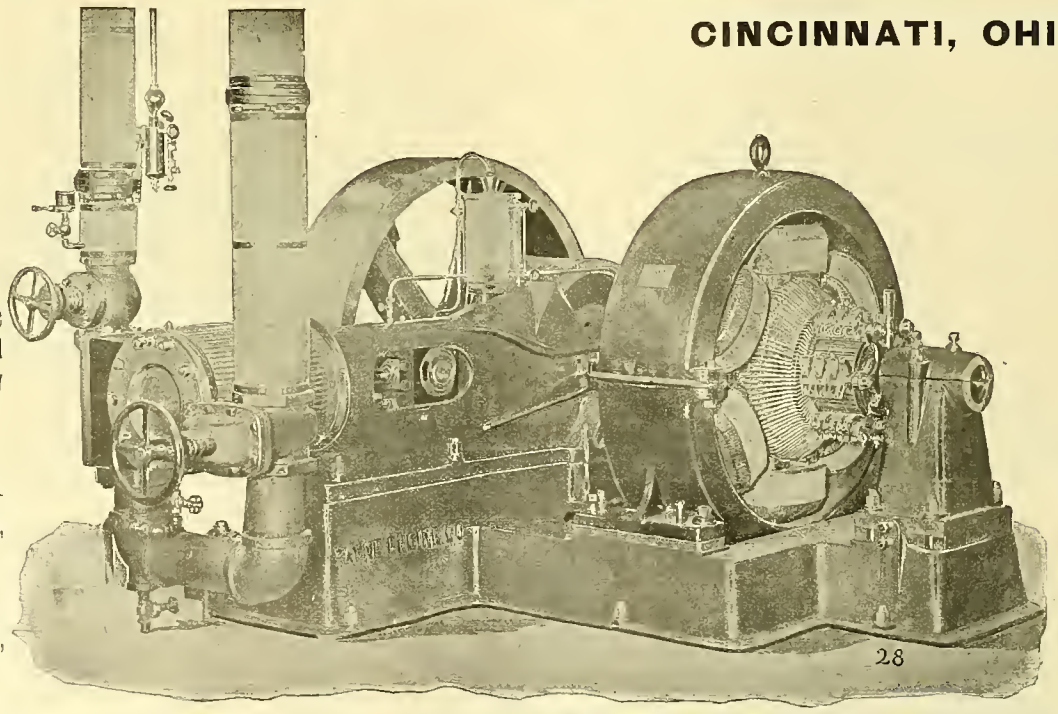

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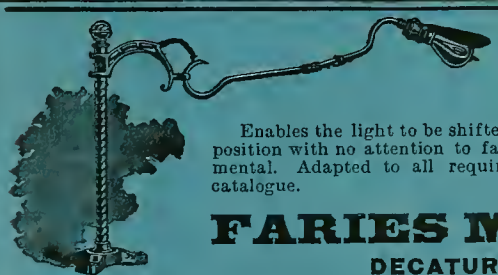

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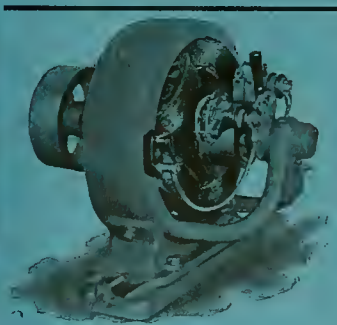

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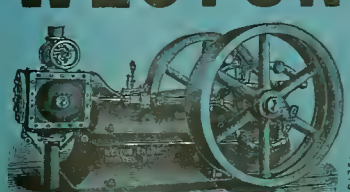

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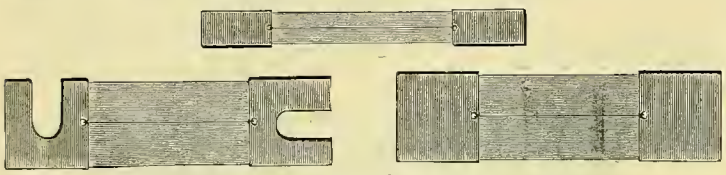

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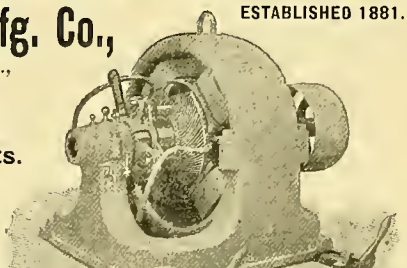

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HARDTMUTH CORED CARBONS for Direct and Alternating Current ARC LAMPS.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

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Incorporated 1892.

E. H. PHIPPS, President.
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CHARLES WARD, Gen. Mgr.

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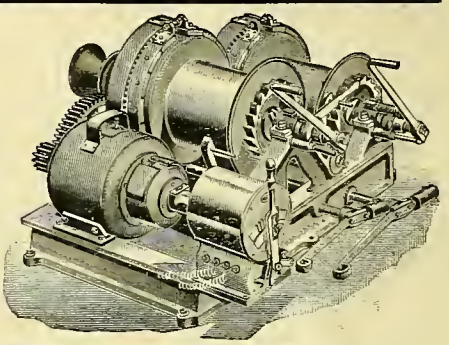

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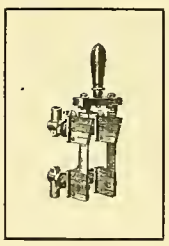

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The courts of last resort in patent causes have repeatedly and recently sustained BRUSH PATENTS FOR STORAGE BATTERIES, Nos. 266,090 and 337,299, dated October 17, 1882, and March 2, 1886, covering broadly every practical type of storage battery plate, including not only pasted plates, but also the so-called Plante plates, in the words of JUDGE SHIPMAN (52d Fed. 130): "A secondary battery plate ribbed, honeycombed, studded or equivalently prepared . . . . in which the Plante process of electrical disintegration or some kindred process of forming was used."

In the interest of the development of the storage battery business these fundamental or basic patents have been acquired at great expense by the **ELECTRIC STORAGE BATTERY COMPANY**, and users, vendors and makers of storage batteries and storage battery plates are cautioned against their infringement.

To guard users, vendors and purchasers against inadvertent and unadvised infringement, notice is hereby given that the types of batteries and plates advertised by the following:

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The American Battery Company,
Samuels Dynamic Accumulator Company,
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Are considered flagrant infringements; and further, that vendors, purchasers and users thereof will be prosecuted by injunction and otherwise according to law.

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Tagatz, H. A.
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Akron Ins. & Marble Co.
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Central Electric Co.
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Empire China Works.
General Electric Co.
Imperial Porcelain Works.
McKeague, J. B.
Peru Elec. Mfg. Co.
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Electrician Publishing Co.
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Rockwood Mfg. Co., The.
Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.
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Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
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Whitney Elec. Inst. Co.
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Robertson & Sons, J. L.
Steam Heating.
Webster & Co., Warren.
Steel Pipe.
National Tube Works Co.
Storage Batteries.
Electric Storage Battery Co.
N. Y. Accum. & Elec Co.
Supporters, Inc. Lamp.
Faries Mfg. Co
Tapes, Insulating.
American Electrical Works.
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Okonite Co., The.
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Standard Paint Co.
Washburn & Moen Mfg. Co.
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Electric Appliance Co.
Western Electric Co.
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Elec. Sup. & Telep Co.
International Elec. Co.
Kusel, D. A. Tel. Mfg Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Standard Tel. & El. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Electric Co.
Western Tel. Cons. Co.
Whitman & Couch.
Transformers.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.
Trolley Cord.
Samson Cordage Wks.
Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co.
Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.
Water Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.
Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
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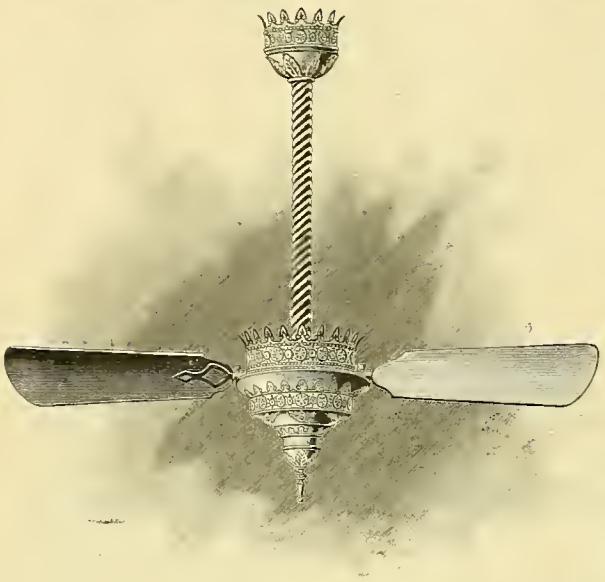

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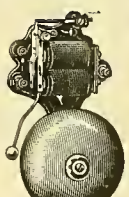

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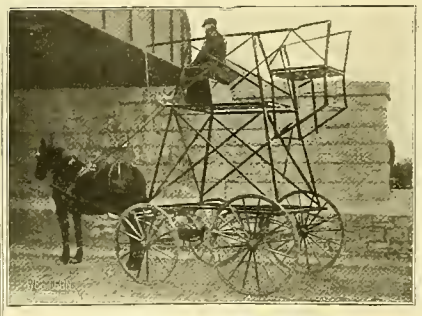

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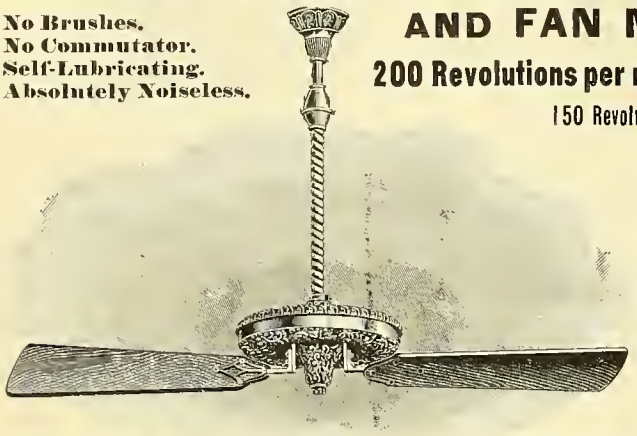

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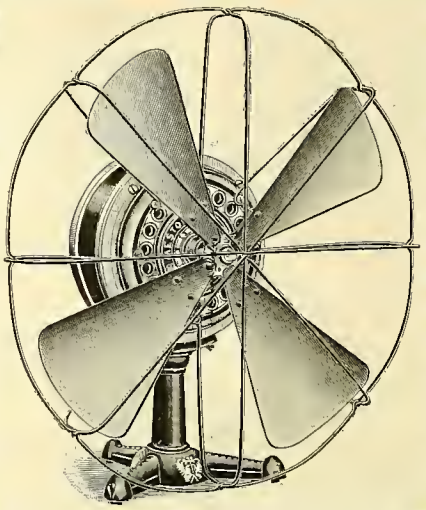

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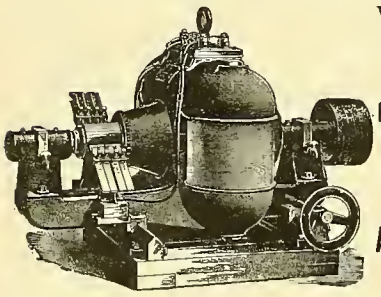

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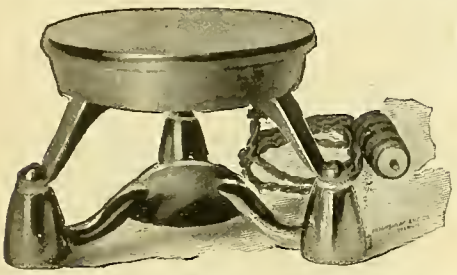

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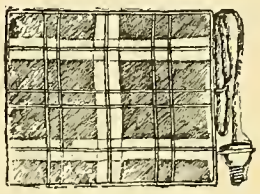

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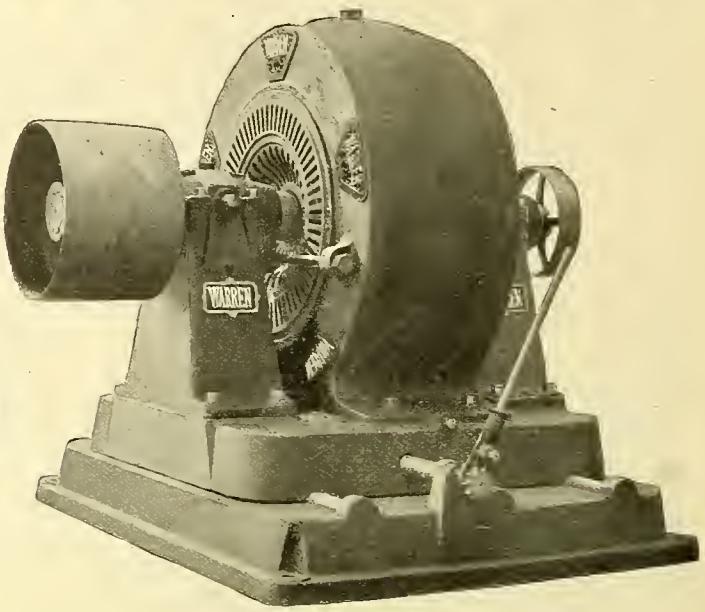

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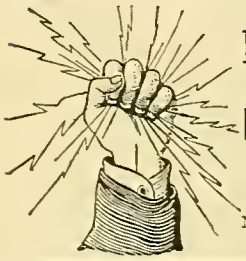

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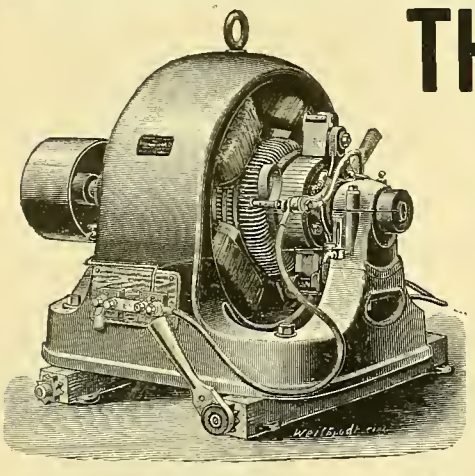

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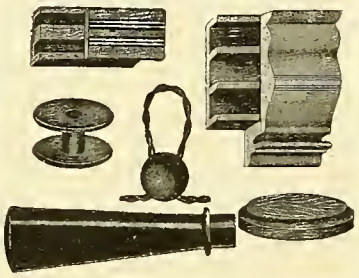

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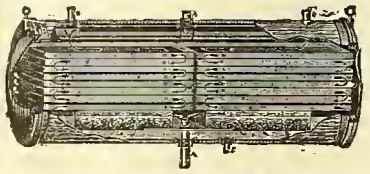

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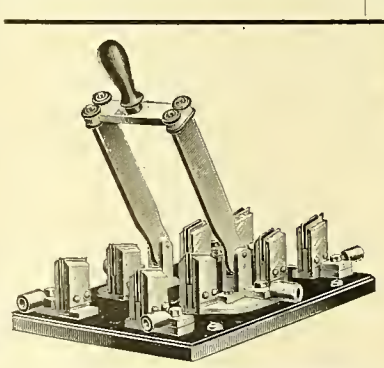

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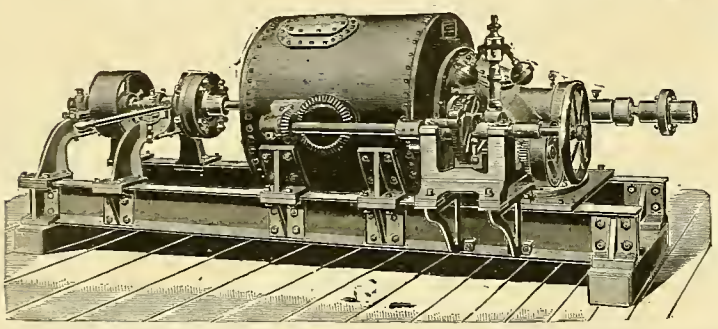

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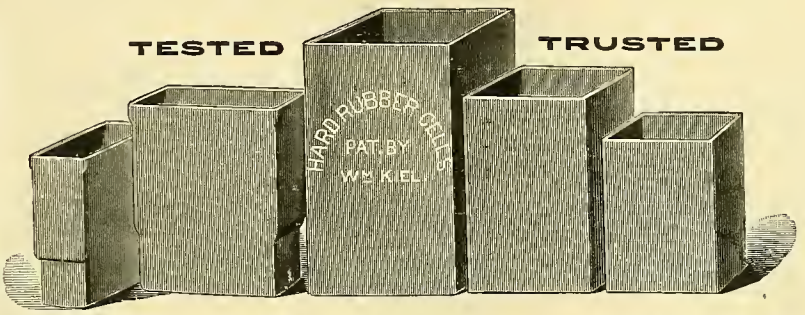

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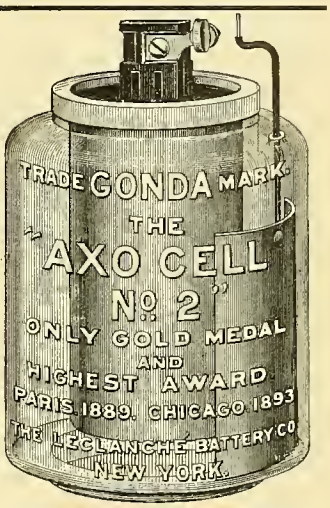

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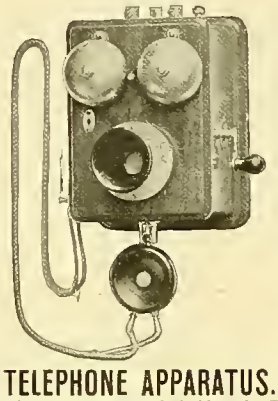

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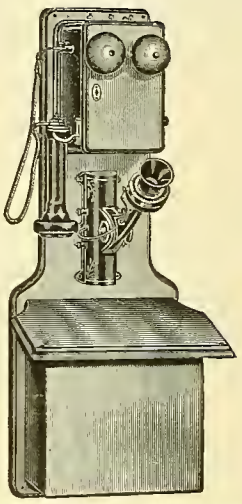

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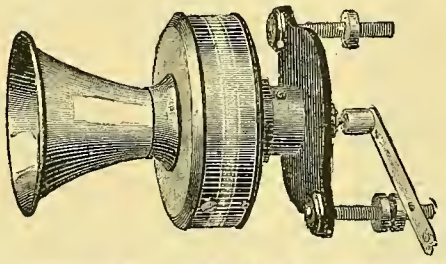

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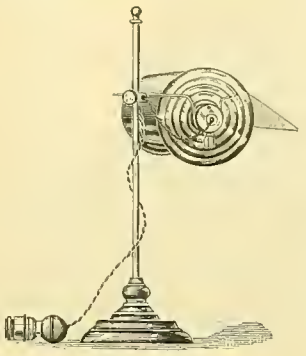

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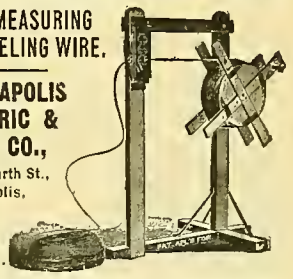

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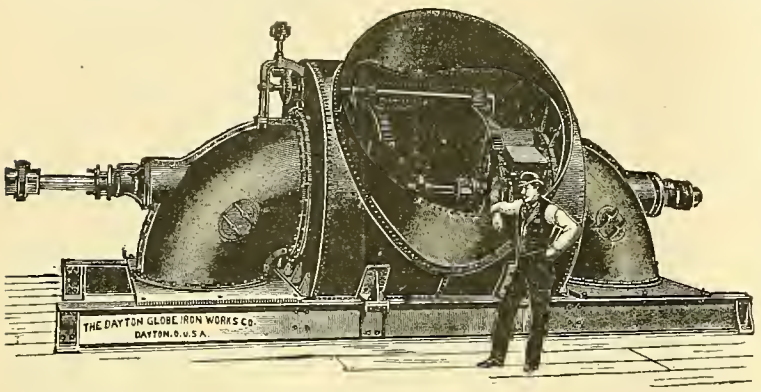

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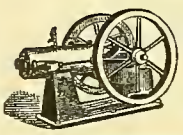

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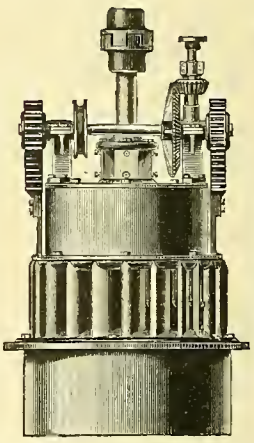

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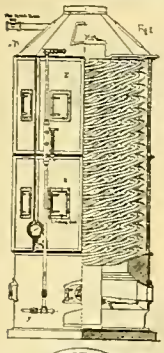

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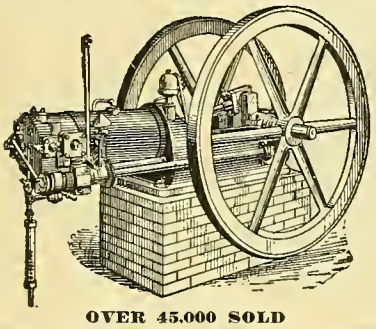

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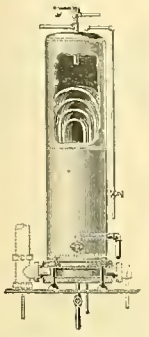

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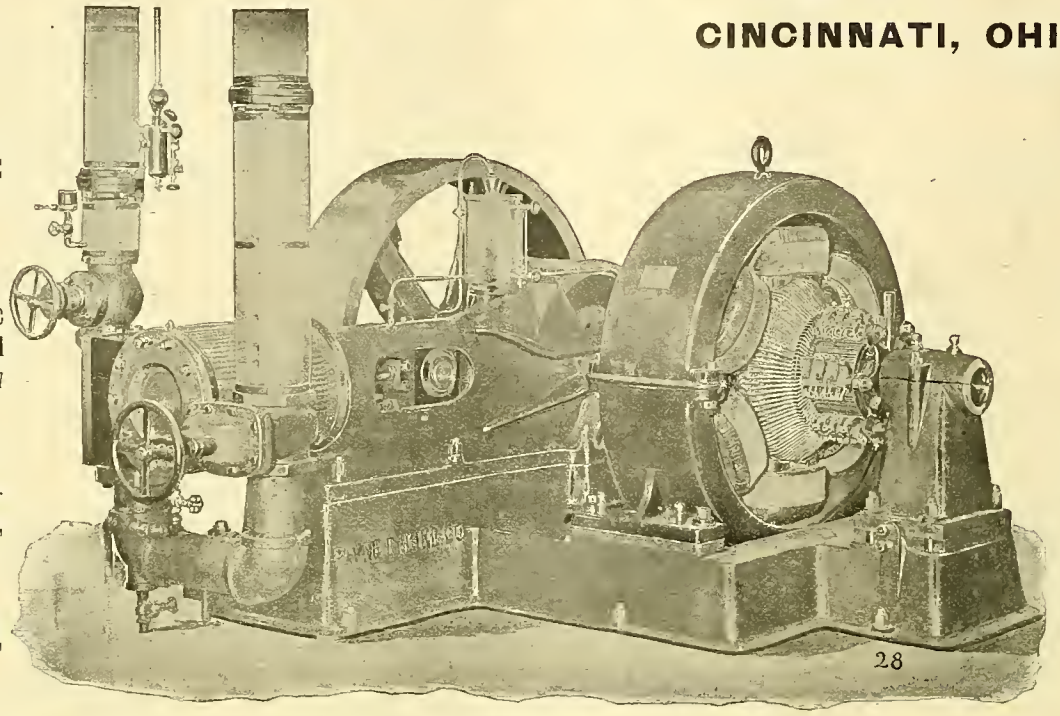

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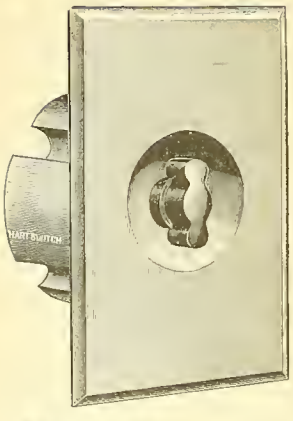

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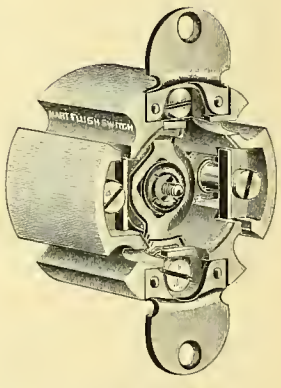

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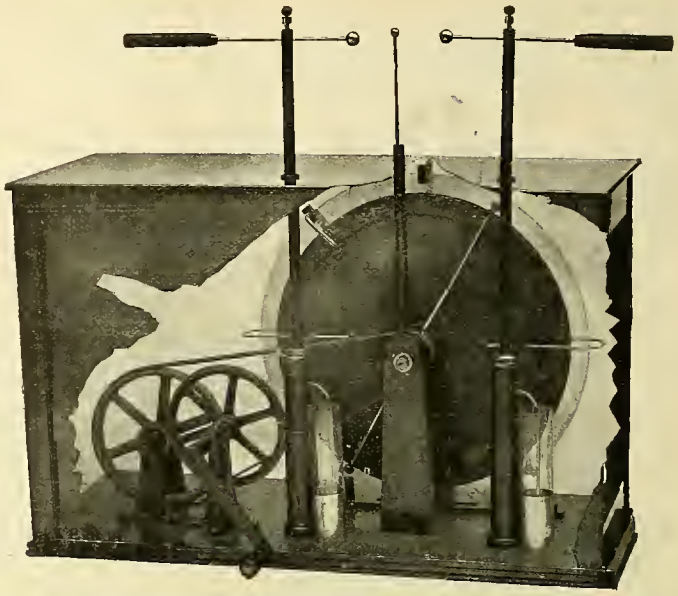

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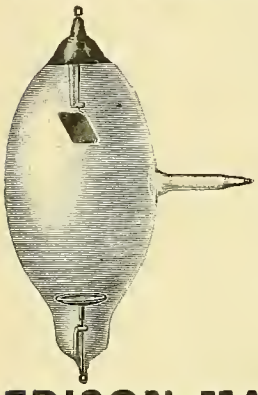

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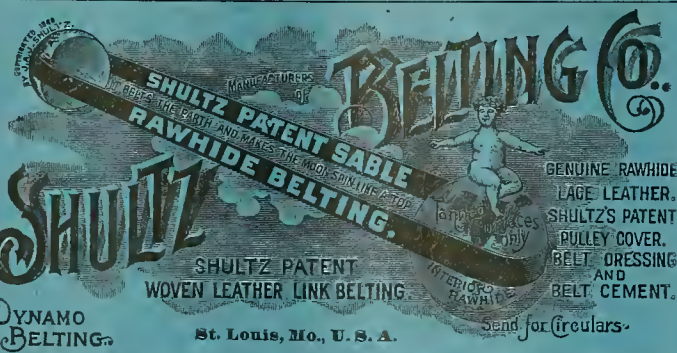

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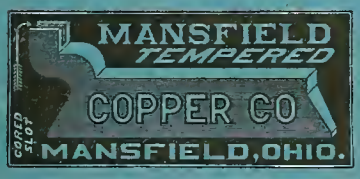

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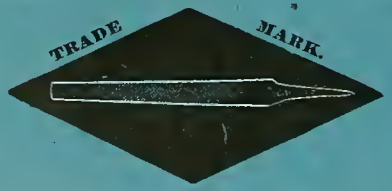

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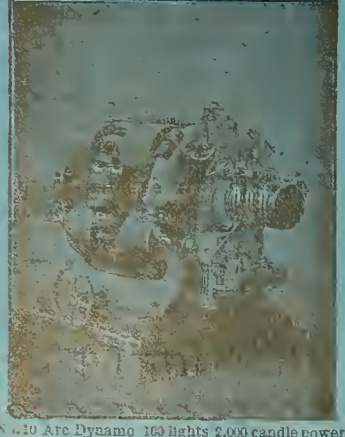
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Vol. XX. CHICAGO; APRIL 10, 1897. No. 15

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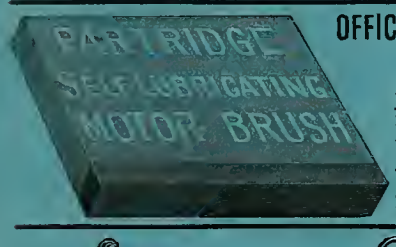

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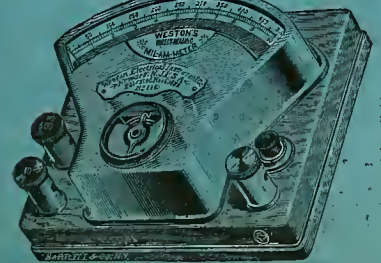

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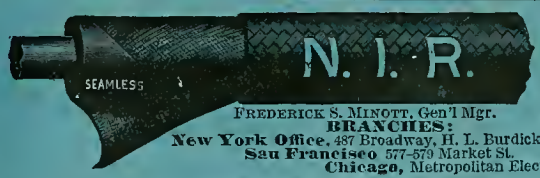

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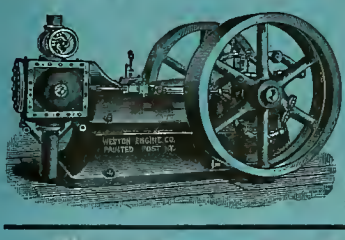

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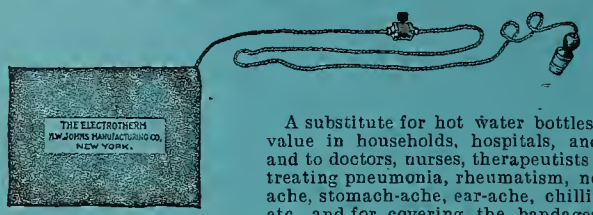

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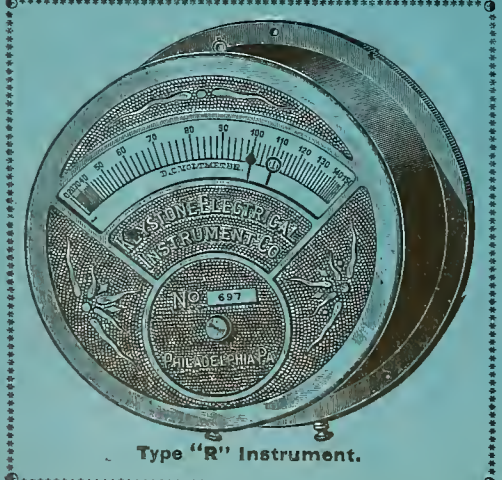

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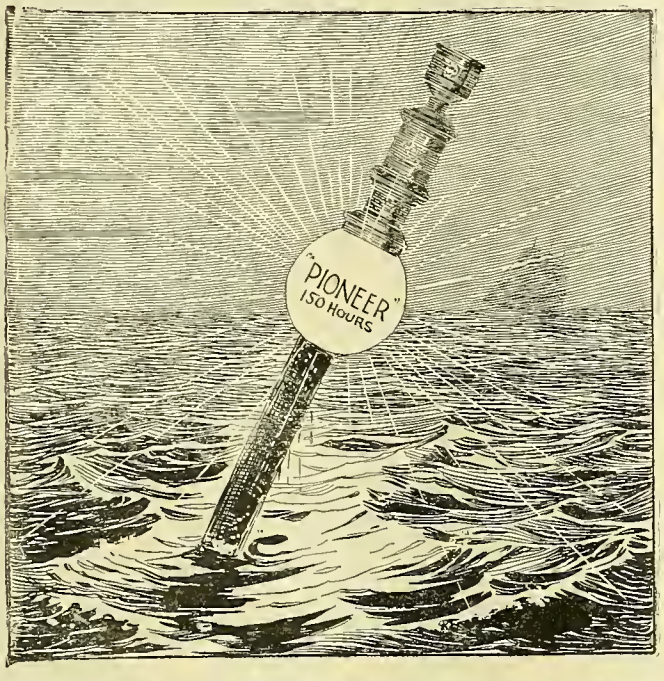

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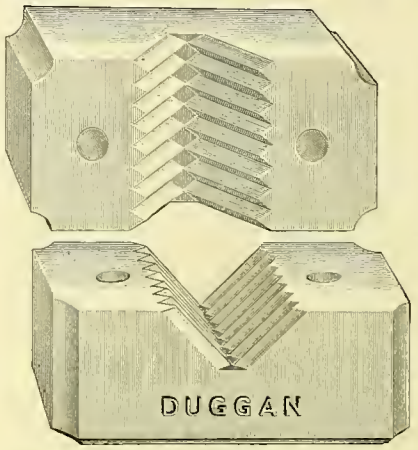

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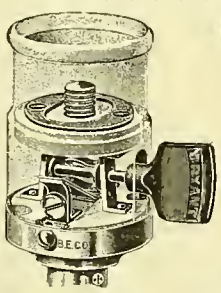

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Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

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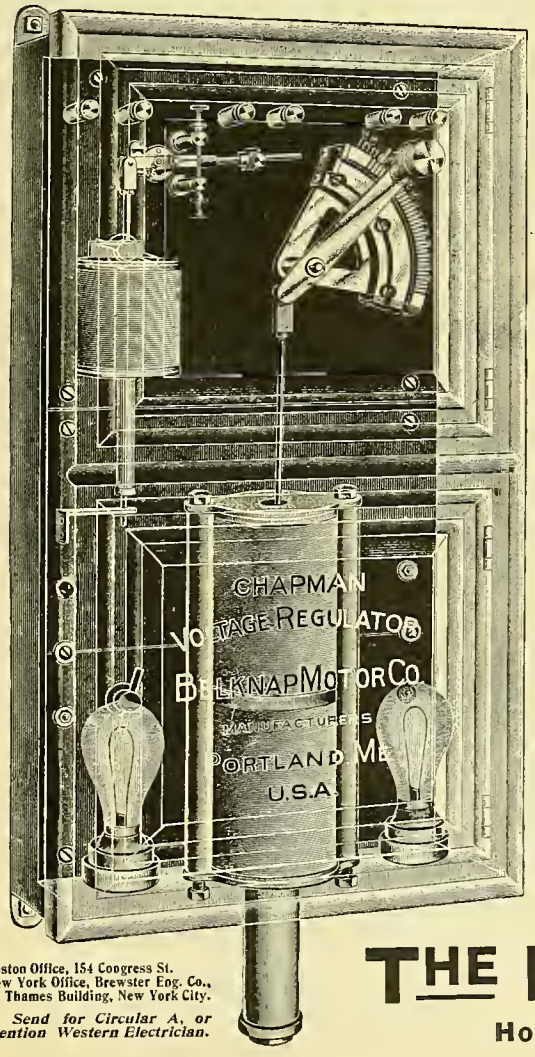

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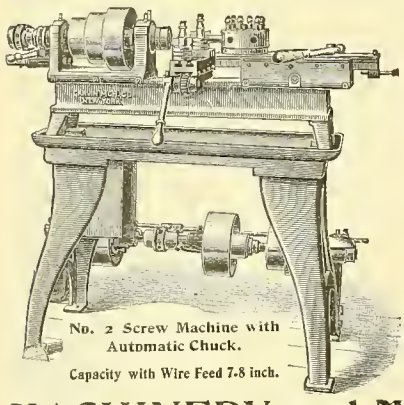

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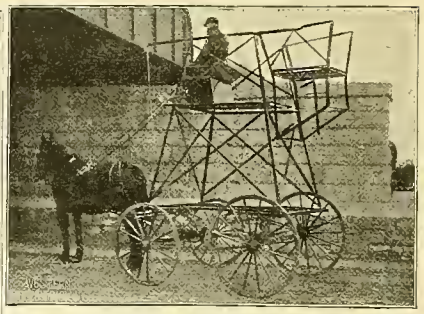

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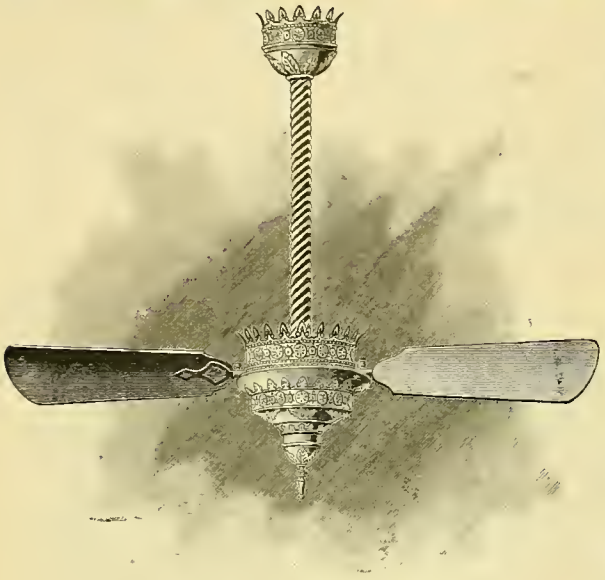

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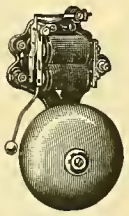

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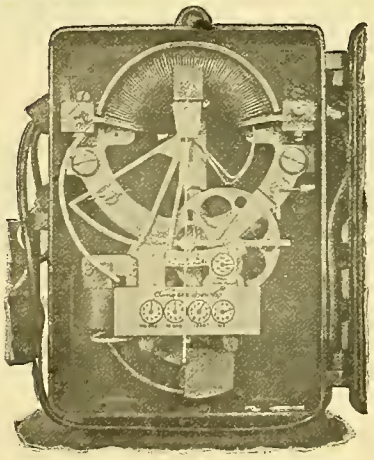

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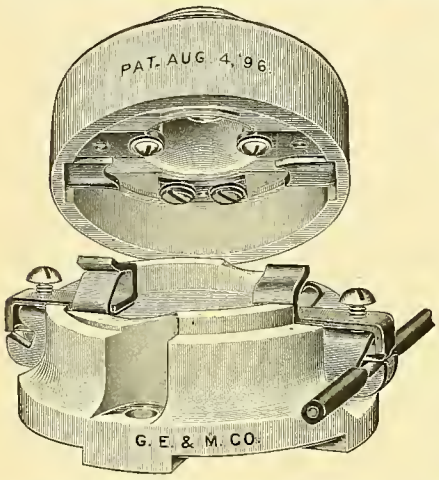

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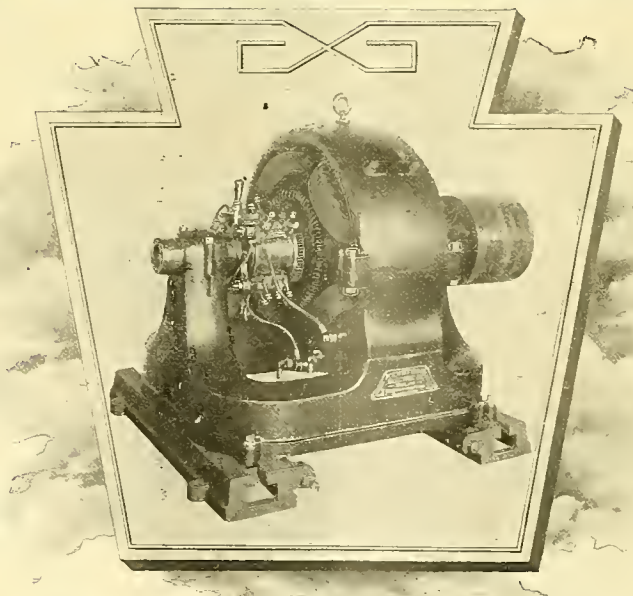

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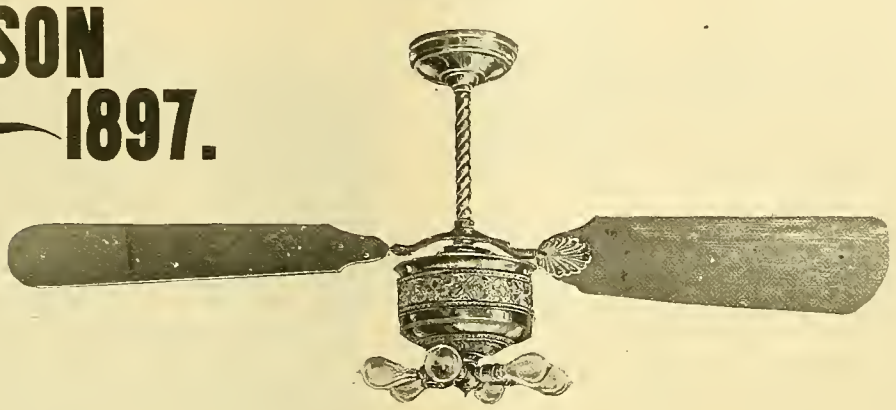

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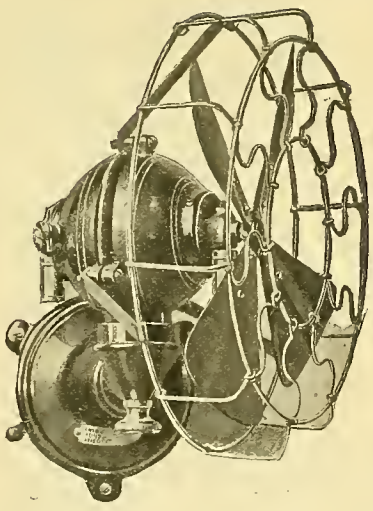

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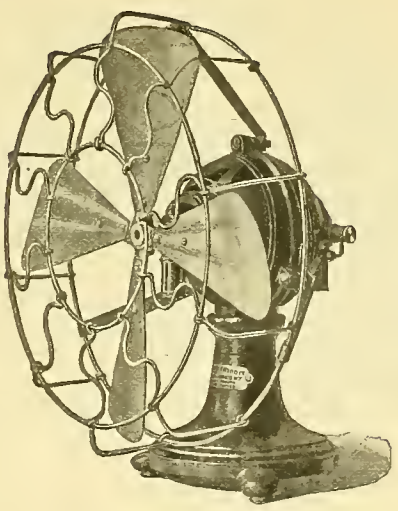

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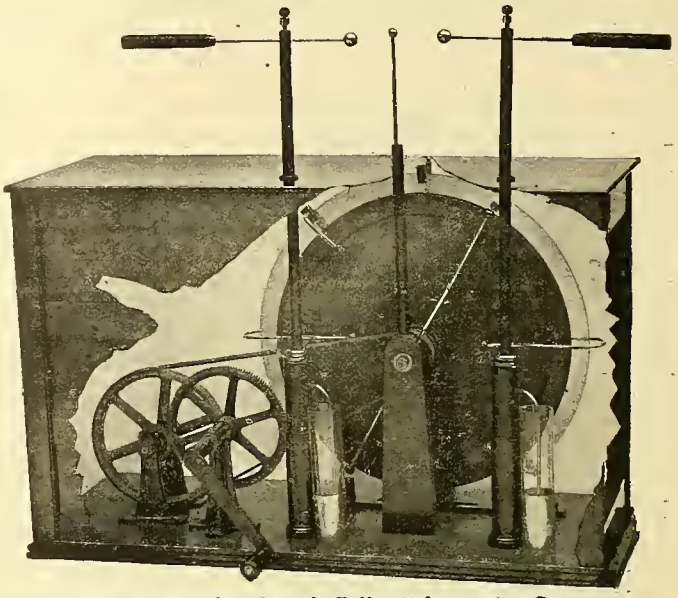

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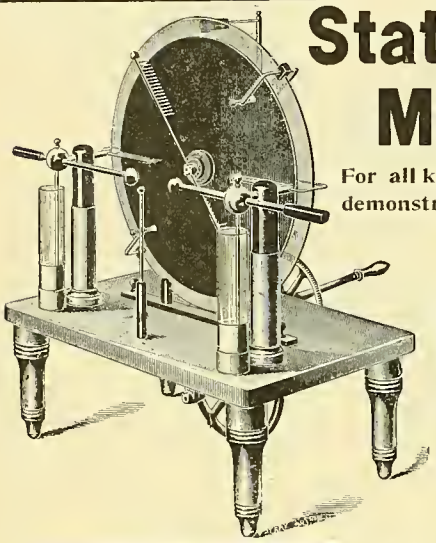

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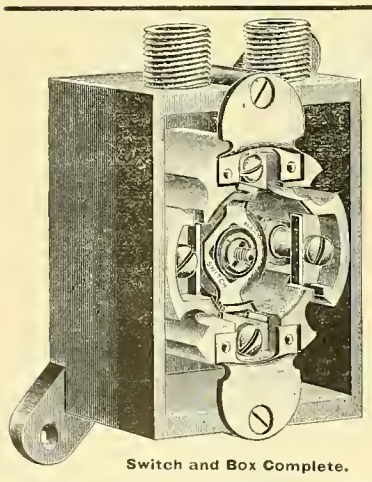

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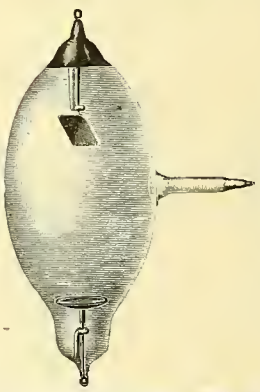

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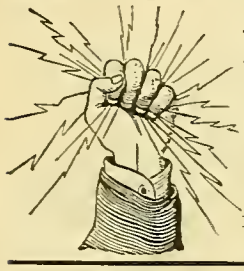

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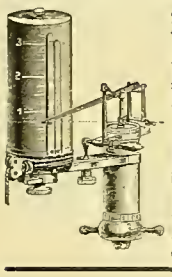

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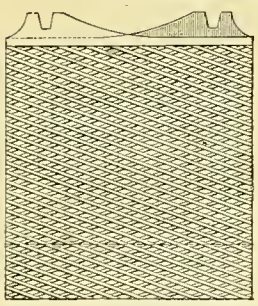

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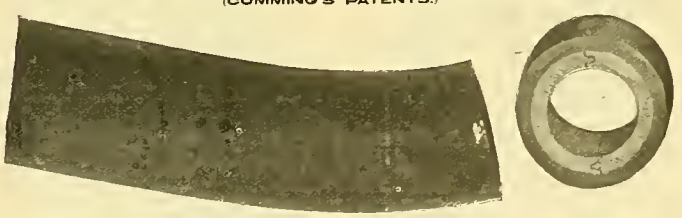

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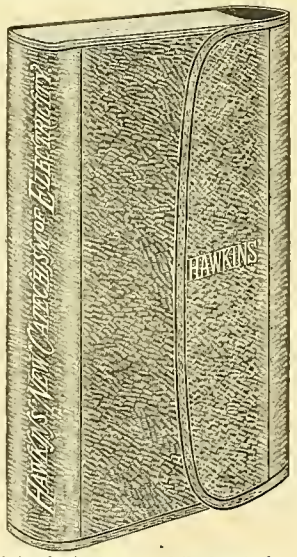

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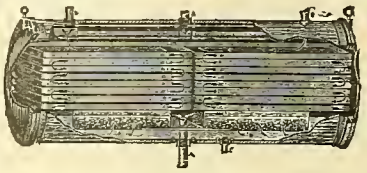

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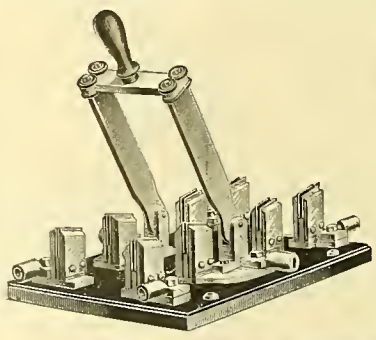

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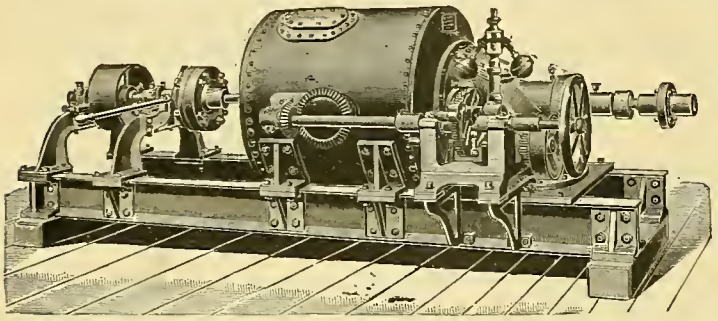

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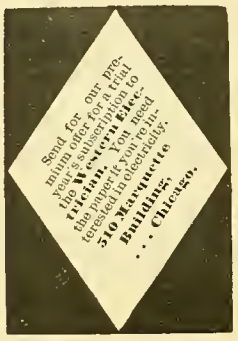

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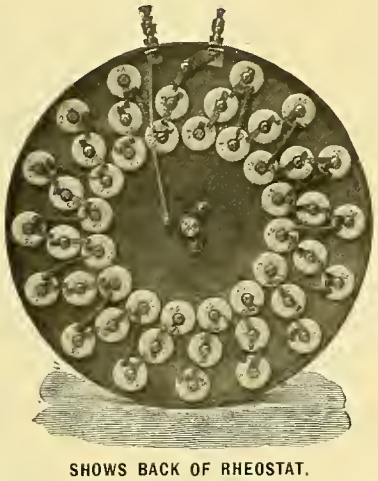

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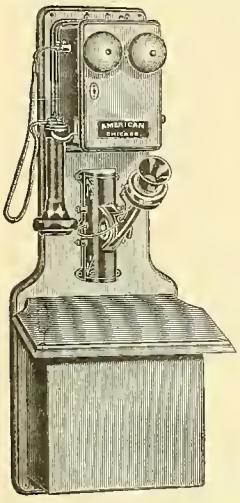

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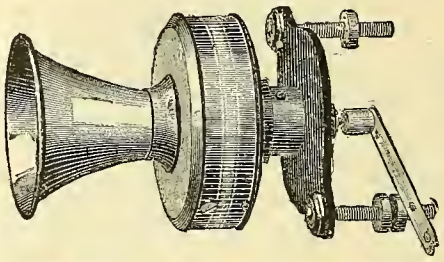

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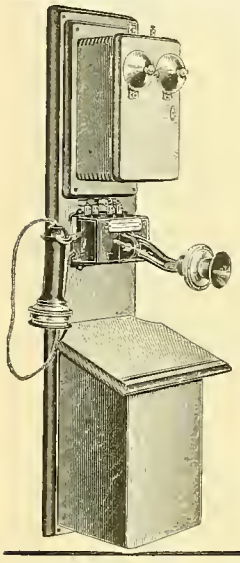

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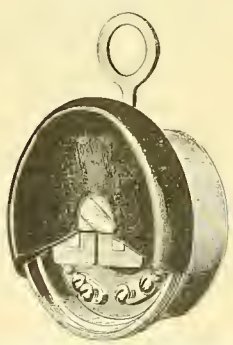

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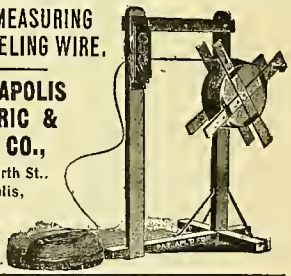

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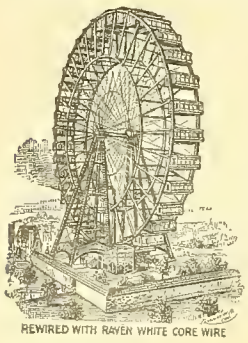

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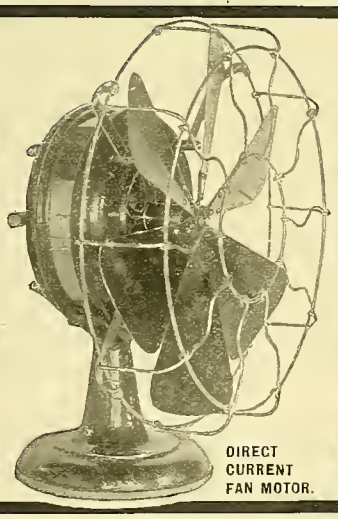

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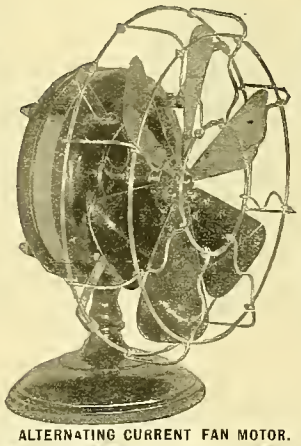

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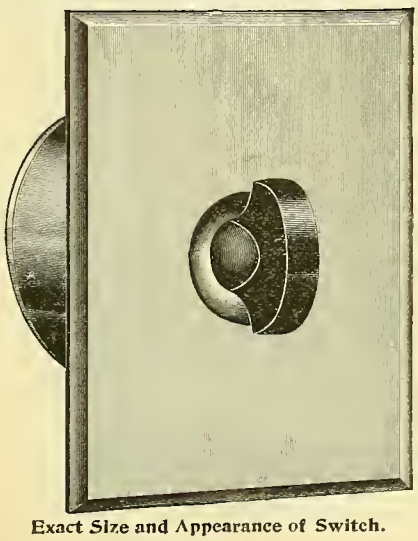

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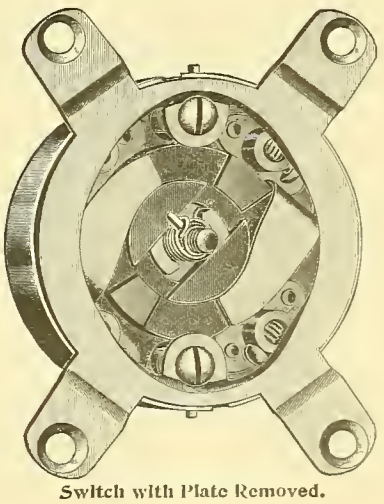

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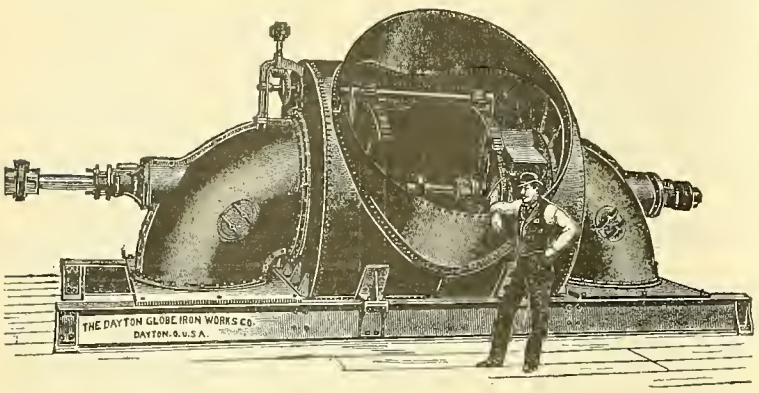

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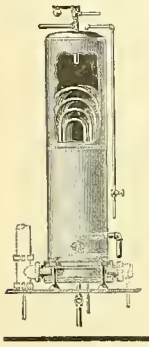

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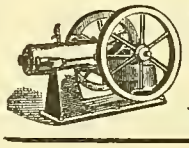

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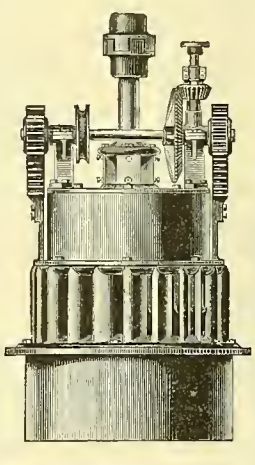

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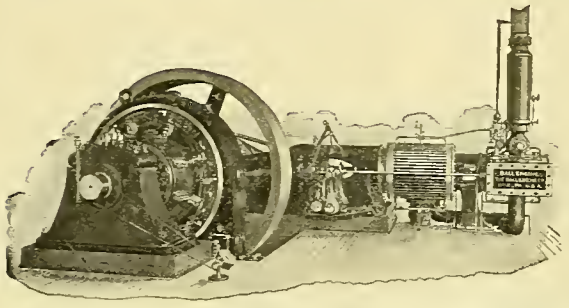

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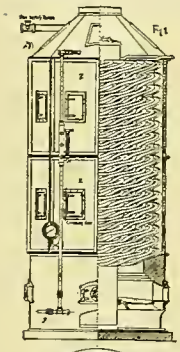

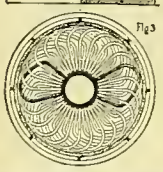

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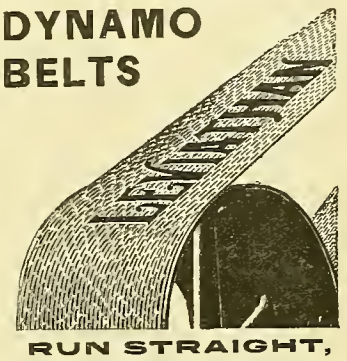

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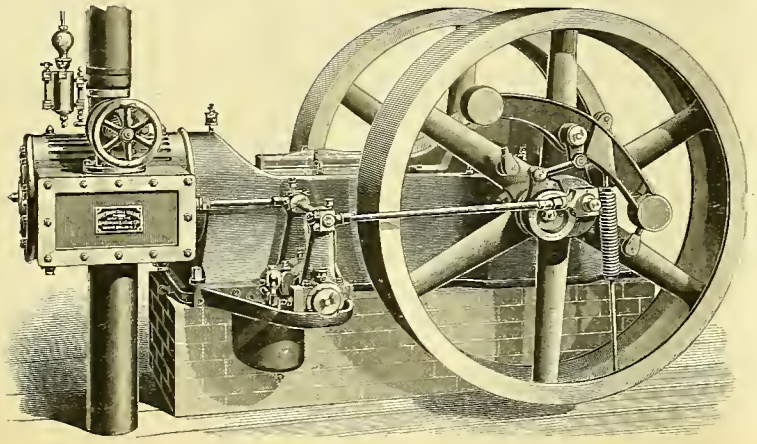

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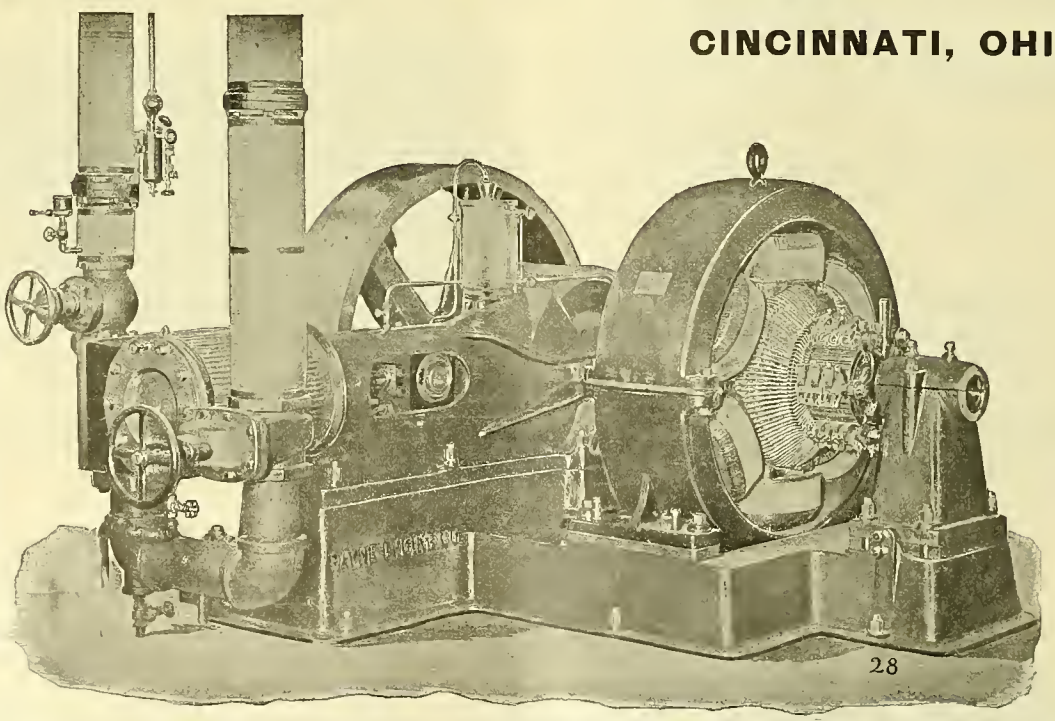

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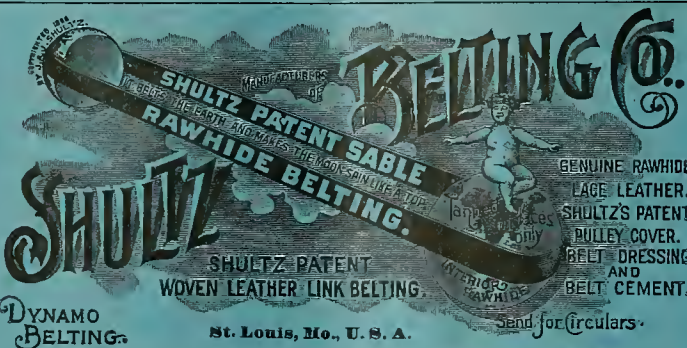

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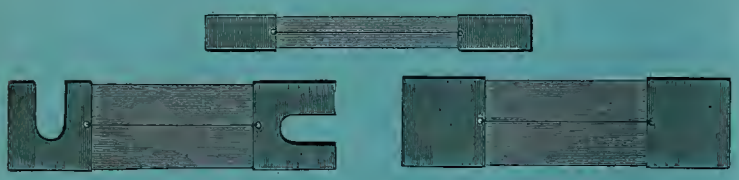

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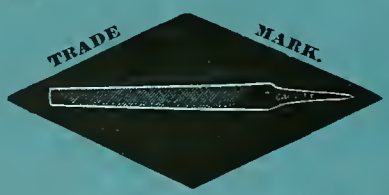

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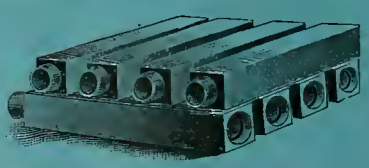

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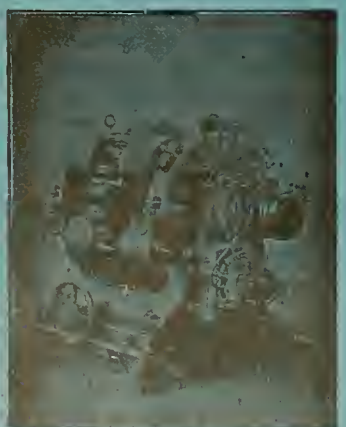

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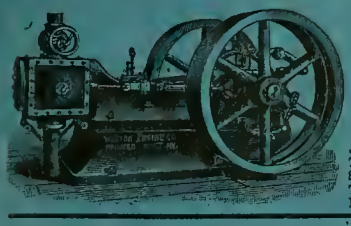

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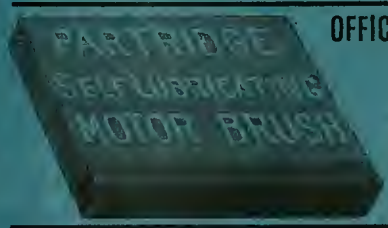

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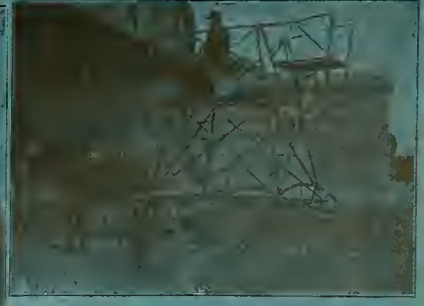

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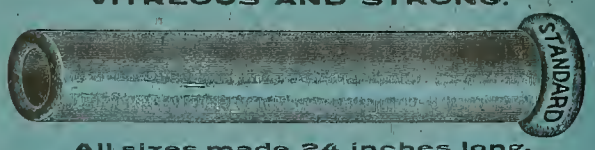

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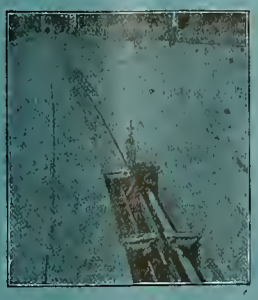

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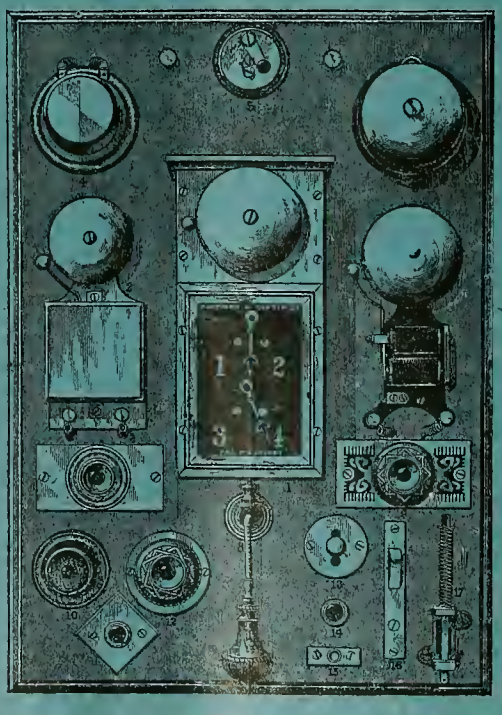

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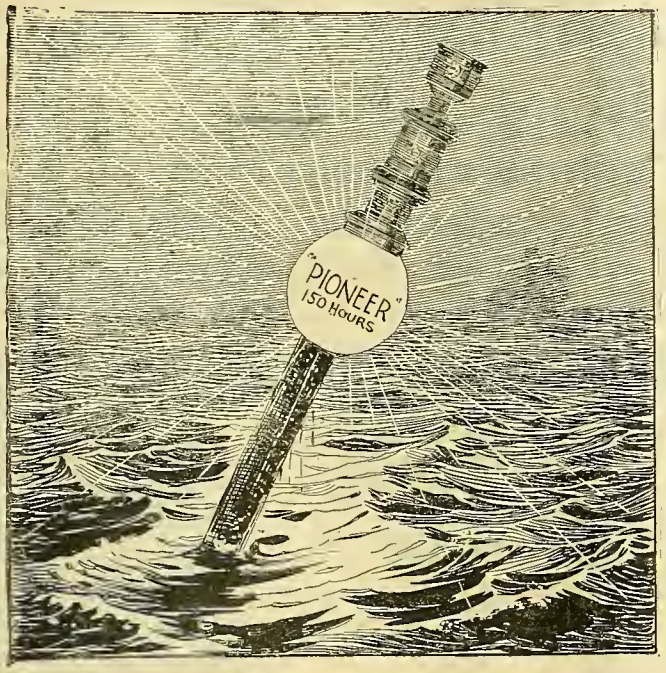

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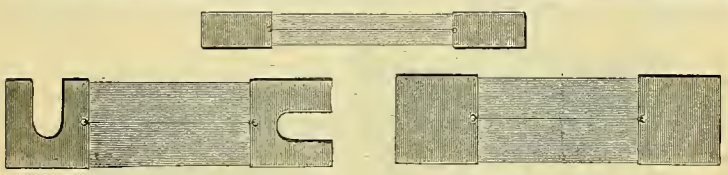

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HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

AMERICAN CARBON CO.'S Plain and Coated CARBONS FOR SERIES ARC LIGHTING.

GENERAL WESTERN AGENTS.

Chicago Edison Co.,

DEALERS IN ELECTRIC LIGHTING SUPPLIES,

139 Adams Street, CHICAGO.

HABIRSHAW AND G. E. CO.'S WIRES AND CABLES.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: NEW HAVEN, CONN.

The Connecticut Pipe Manufacturing Company,

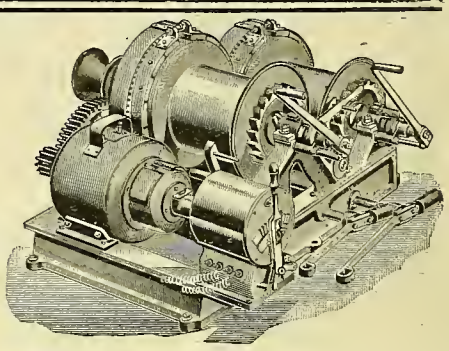
Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

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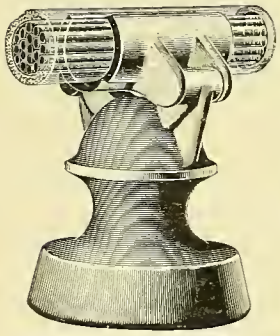
CHICAGO OFFICE: Metropolitan Elec. Co., 186-188 Fifth Ave.
NEW YORK OFFICE: 136 Liberty Street.
BRANCH FACTORY: Hamilton, Canada

"H. W. J." Toggle Clamp Feed Wire Insulator.



The weight of the wire io the hinged jaws automatically causes the wire to be clamped with a powerful toggle action. Wire may be instantly detached from insulator by lifting it out.

NO BINDING WIRES, NO SCREW CAP, NO DELAYS.

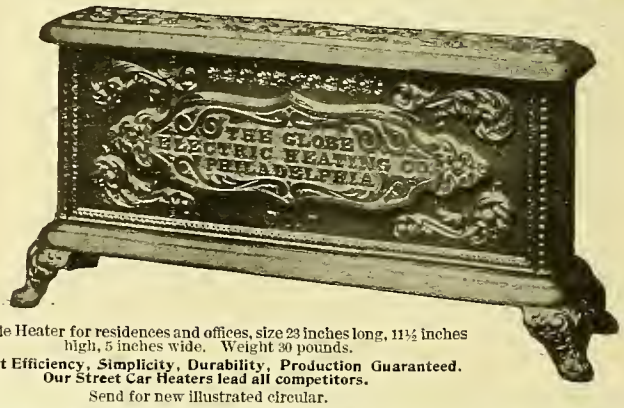
Economical, durable. No abrasion of insulation.

Trolley Line Insulators, Giant Strains, Philadelphia Section Insulators, Etc.
Vulcabeston Parts for Controllers, Motors, Etc.

H. W. JOHNS MFG. CO.,

240 Randolph Street, Chicago.
New York. Boston. Philadelphia. London.

ELECTRIC HEATERS AVAILABLE TO ALL. MINIMUM EXPENSE.



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Our Street Car Heaters lead all competitors.

Send for new illustrated circular.

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Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
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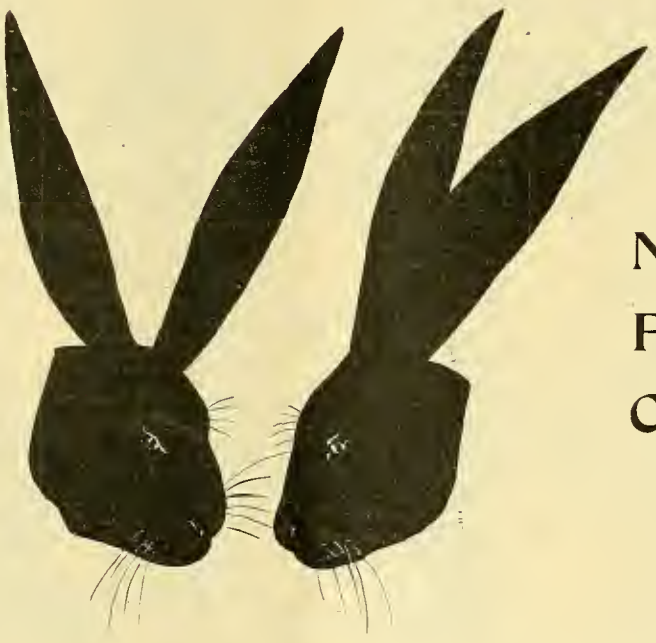
Westinghouse Electric Co., Ltd., 32 Victoria St., London, S.W., England.
32 Ave. de l'Opera, Paris, France.
For Canada address Ahearn & Soper, Ottawa, Ont.

The Good Points

On our **Fan Motors Stick Out Like**



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WAGNER DIRECT-CONNECTED ALTERNATING CURRENT CEILING FANS.
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ATTICA, March 3, 1897.

The Static is working very nicely. You have the finest Static on the market.

Yours truly,
W. B. GIFFORD, M. D.

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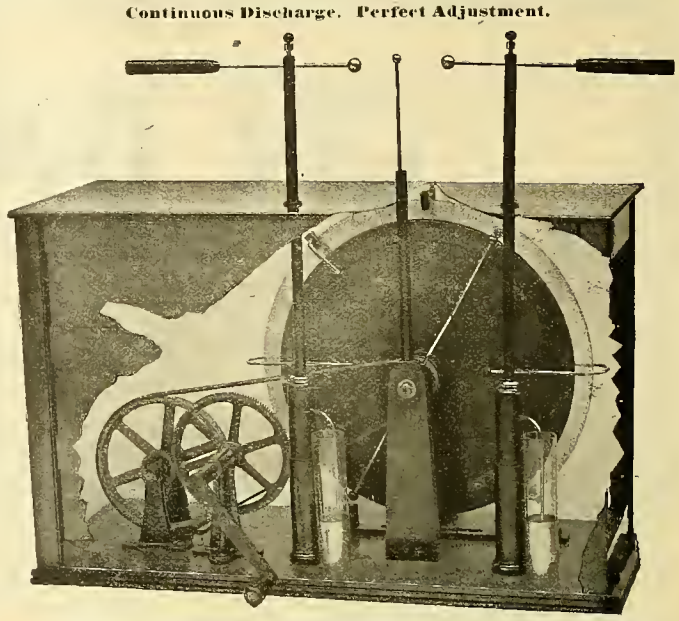
HIGH FREQUENCY COILS. FLUOROSCOPES.

Continuous Discharge. Perfect Adjustment.



Influence Machine, from L. E. Knott Apparatus Company.

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Hodge, Walsh & Loring.
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Locke, Fred. M.
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Okonite Co., The.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

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Brixey, W. R.
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Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
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Lamps, Incandescent.
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Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

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Stilwell-Bierce Smith-Valle

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McLaurin & McLaren.
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General Electric Co.
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American Engine Co.
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General Electric Co.
Interior Conduit & Ins. Co.
Keystone Electric Co
Metropolitan Electric Co.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

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Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

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Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

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Lindsley Bros.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
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Akron Ins. & Marble Co.
Bryant Electric Co.
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Imperial Porcelain Works.
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Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Reels, Wire.
Minneapolis El. & Cons Co.

Refiners.
Swarts Metal Refining Co.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.

Rheostats.
Am. Heating Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Westinghouse El. & Mfg. Co.

Search Lights.
Carlisle & Finch.

Second-Hand Machin'y.
Electrical Exchange, The.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Steam Gauges.
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Steam Heating.
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Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
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Tapes, Insulating.
American Electrical Works.
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Commercial El Supply Co.
Electric Appliance Co
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Kusel, D. A. Tel. Mfg Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl M Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Water Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

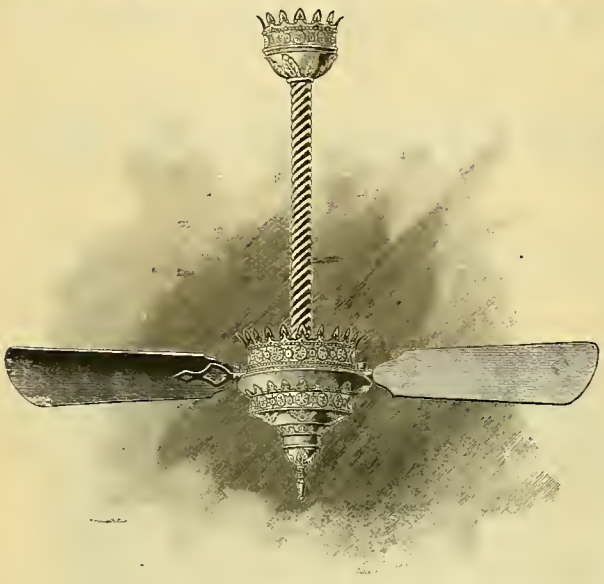
Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
Washburn & Moen Mfg. Co.

Wire Joints.
American Elec. Fuse Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Edison Mfg. Co.
Knott, L. E. Apparatus Co.
Queen & Co.
Spring Park Laboratory.
Swett & Lewis.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

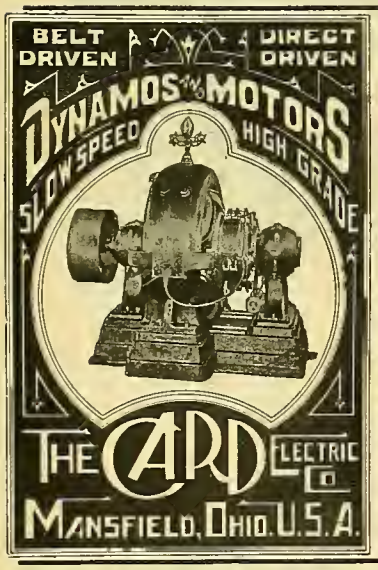
OUR '97 FAN CATALOGUES ARE NOW READY.

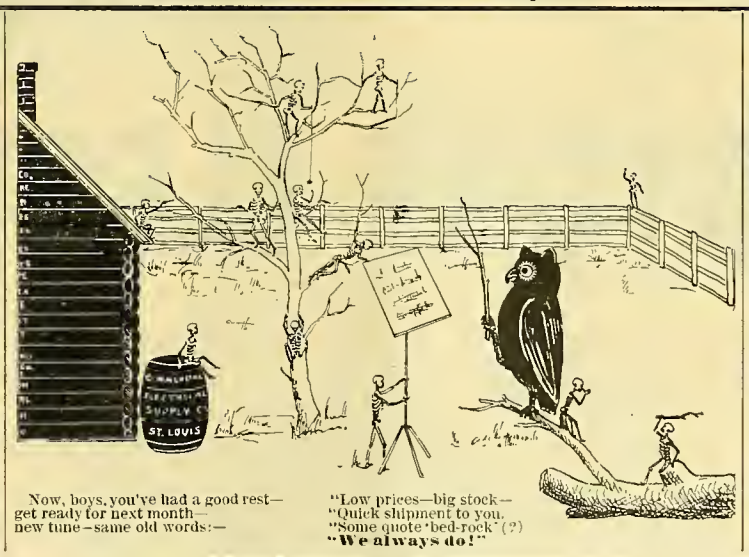
Any of Our Fans Furnished with Four Blades if so Ordered.

SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.

CHICAGO, 192-194 VAN BUREN STREET.

DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

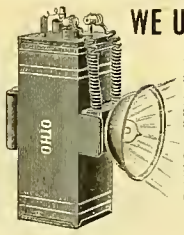




Now, boys, you've had a good rest—
get ready for next month—
new tune—same old words:—

"Low prices—big stock—
"Quick shipment to you.
"Some quote 'bed-rock' (?)
"We always do!"

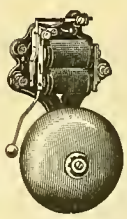
It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
88 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.50

Agents Wanted.
Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
Ohio Electric Works,
E. S. Water St.,
Cleveland, Ohio.



BELLS
—AND—
PUSH BUTTONS.
Exclusive Features.
Send for New Catalogue.
Huebel & Manger,
MANUFACTURERS,
Style F. 290 Graham St., Brooklyn, N. Y.

Fort Wayne Electric Corporation,
FORT WAYNE, IND.

Apparatus for

Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.

Given Away—

Our new catalogue of Electrical Books. Contains 100 pages, listing all electrical books to date of publication. Send for a copy, mailed free to any address. Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.

DYNAMOS AND MOTORS 1 to 30 H.P.

REPAIRS!

CHICAGO ARMATURE CO.,
14 to 18 N. CANAL ST. CHICAGO.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

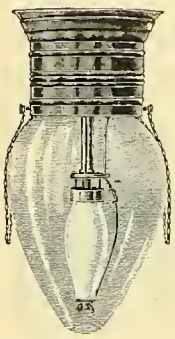
SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

Best, Smallest and Cheapest.



THE UPTON MIDGET ENCLOSED ARC LAMP.

BURNS 150 HOURS. 20 INCHES LONG.

We make these Lamps for **Low Tension, High Tension, and Street Railway Circuits.** Least possible mechanism. Cheapest to buy and maintain.

WE ALSO MANUFACTURE OPEN ARC LAMPS FOR ALL CIRCUITS.

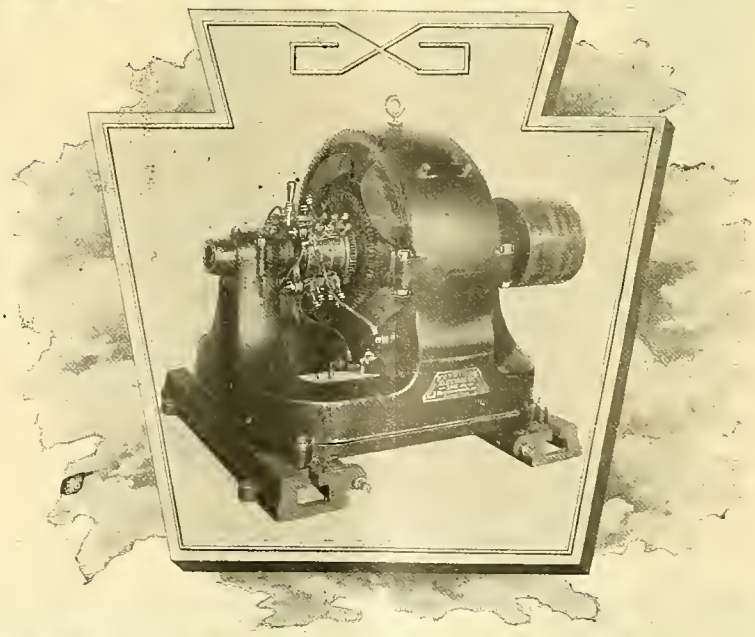
Branch Offices:

J. H. BUNNELL & CO., New York.
ELECTRIC APPLIANCE CO., Chicago.
ETHERINGTON & CO., Philadelphia.
DUNHAM, CARRIGAN & HAYDEN CO., San Francisco.

Standard Thermometer & Electric Co.,

PEABODY, MASS.

KEYSTONE ELECTRIC



Erie, Penn.

COMPANY.

"THE ELECTRA"

ELECTRA ·TRADE MARK·

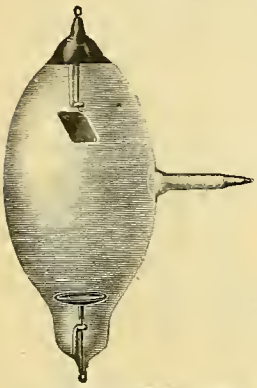
HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

THE ONLY GENUINE EDISON



X-RAY APPARATUS AND FOCUS TUBES

ARE MANUFACTURED BY

THE EDISON MANUFACTURING COMPANY.

Special Focus Tubes for Battery X-Ray Sets.
Special Focus Tubes for Direct Current X-Ray Sets.
Special Focus Tubes for Static Machine Work.
3, 4, 6, 8, 10 and 12 inch X-Ray Sets for Battery and 120-Volt Direct Current.

WRITE FOR NEW CATALOGUE.

ALL OUR FOCUS TUBES ARE MANUFACTURED AT THE

EDISON LABORATORY.

EDISON MANUFACTURING CO.,

110 EAST 23d STREET, NEW YORK.

THE NEW NON-PHOSPHORESCENT CRYSTALS.

POSITIVELY SUPERIOR TO CALCIUM TUNGSTATE OR ANY OTHER KNOWN SALT.

These highly fluorescent crystals accomplish the result of showing each image undimmed by previous exposure or phosphorescence, makes clear the most vague shadows which cannot be traced when calcium tungstate is used, and is absolutely instantaneous in effect.

IMPORTANT TO EVERY X-RAY INVESTIGATOR.

FLUORESCENT SCREENS, FLUOROSCOPES, CALCIUM TUNGSTATE CRYSTALS, SCIENTIFIC AND ELECTRICAL INSTRUMENTS, SPECIAL APPARATUS TO ORDER. . . . . .

MADE ONLY BY THE

SPRING PARK LABORATORY,

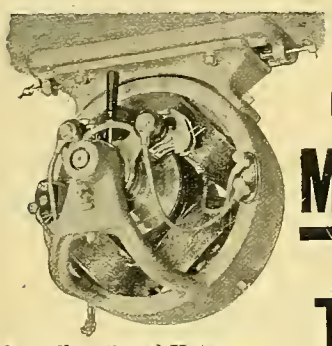
38 Spring Park Ave., JAMAICA PLAIN, MASS.

PORCELAIN MANUFACTORY. Empire City Works. 144-156 GREENE ST. SECTION C. BROOKLYN, N.Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &C

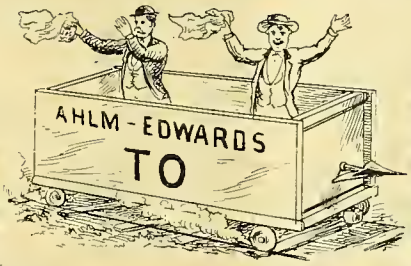
HERCULES BATTERIES. LA CLEDE BATTERIES. PERU ELECTRIC MFG. CO. PERU, IND.

PORCELAIN INSULATION Of all Kinds. We Solicit the making of SPECIAL DESIGNS OF PORCELAIN.



3 h. p. Slow Speed Motor, Suspended from Ceiling.

FROM MEDINA



TO CLEVELAND.

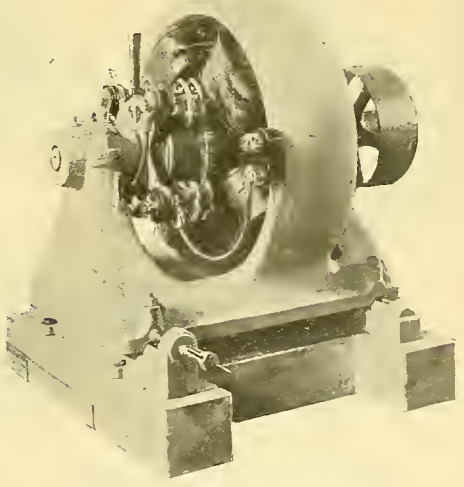
THE AHLM-EDWARDS ELECTRIC CO.

Slow and Moderate Speed Dynamos and Motors.

DIRECT CONNECTED GENERATORS

For Light and Power.

ABSOLUTELY SPARKLESS. HIGHEST EFFICIENCY.



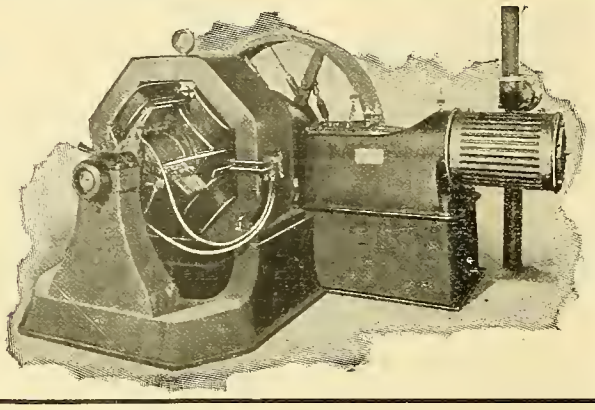
25 K. W. Slow Speed Dynamo.

Owing to rapid increase of business we have moved from Medina to

CLEVELAND, OHIO.

EDDY GENERATORS.

Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.



Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

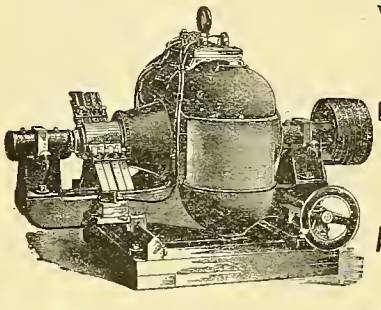
NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.

DALLETT
Electric Motors and Generators,

MANUFACTURED BY

THOS. H. DALLETT & CO.,

York St. and Sedgley Ave.,
PHILADELPHIA, PA.



Portable Electric Drills, Starting Boxes and Controllers,

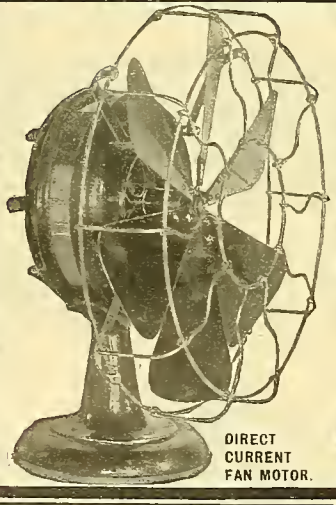
Automatic Switches. . . . . Flexible Insulated Couplings.

"ARMORITE"!
INTERIOR CONDUIT
(CUMMING'S PATENTS.)

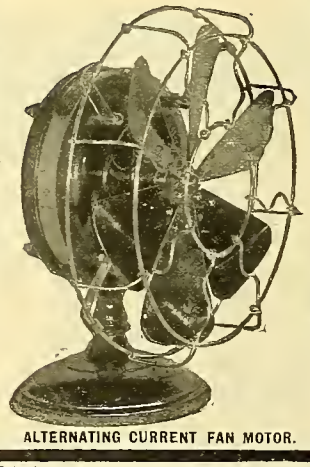
Note how the Wood-Lining does not crack.

ARMORITE INTERIOR CONDUIT CO., OFFICE AND WORKS. 476-486 FORT STREET, WEST, DETROIT, MICH.

ELECTRIC APPLIANCE CO., Chicago, General Western Agents.



DIRECT CURRENT FAN MOTOR.



ALTERNATING CURRENT FAN MOTOR.

G E '97 MODEL.
FAN MOTORS

FOR **ALTERNATING CURRENT**
—AND—
DIRECT CURRENT CIRCUITS.

GENERAL ELECTRIC COMPANY,

SCHENECTADY, N. Y.

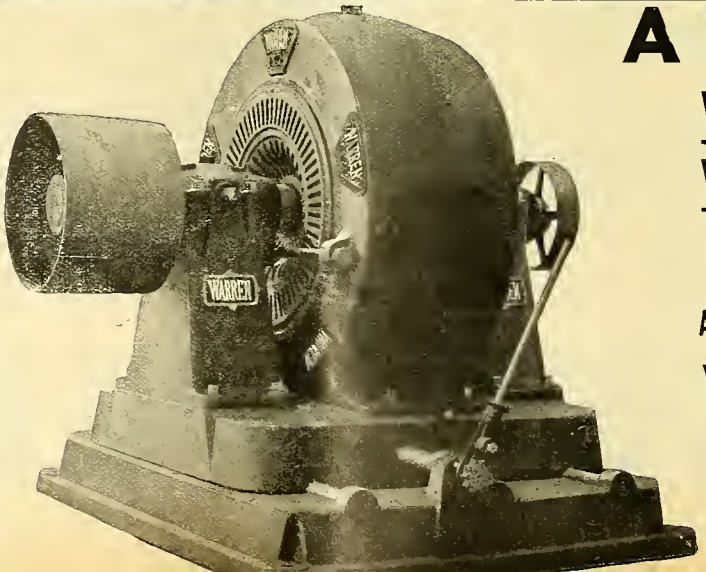
SALES OFFICES IN ALL LARGE CITIES IN THE UNITED STATES.

Out in Arizona

When unloading from a wagon

A Warren Alternator,

The skids gave way and it **TUMBLED OFF** and rolled down **THE MOUNTAIN** side. **WAS HAULED UP,** set up, started up **ALL RIGHT.** This was more than **A YEAR AGO.** It has been running constantly ever since, stopping only **EVERY FIFTH SUNDAY.** This plan of unloading not recommended, but demonstrates the substantial character of **THE WARREN ALTERNATOR.** The Crown King Mining Co., Crown King, Arizona, were the purchasers.



A DYNAMO

Without Moving Wires, Without Brushes.

EFFICIENT, UNEQUALED.

ANY VOLTAGE OR MULTI-VOLTAGE.

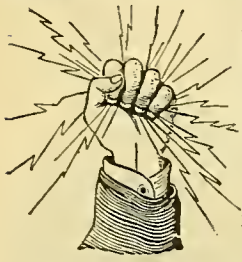
Warren Electric Mfg. Co.,

SANDUSKY, OHIO.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE ONLY
WATER-WHEEL GOVERNOR
THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
WATERVILLE, ME., Jan. 18, 1896.

Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

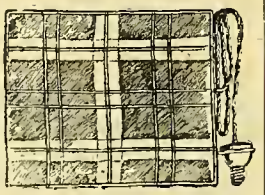
LOMBARD WATER-WHEEL GOVERNOR CO.,
61 Hampshire St., BOSTON, MASS.

$5.00

Electric Stew Pan.

$3.00

Electric Curling Iron Heater.

$5.00

Electric Heating Pad.

Some of our goods which connect to lamp sockets, using from ½ to 2 amperes at 110 volts.

AMERICAN ELECTRIC HEATING CORPORATION.

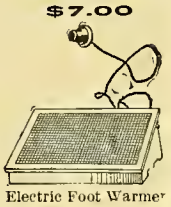
NEW YORK, 39 CORTLANOT STREET. BOSTON, SEARS BUILDING. CHICAGO, MONADNOCK BLOCK.

$4.00

Electric Stove.

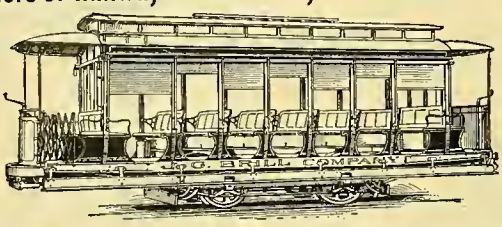
$6.00

Electric Smoothing Irons.

$7.00

Electric Foot Warmer

J. G. Brill Company, Philadelphia,

Builders of Railway and Tramway Cars of all Classes.



Special Attention Given to the Building of Electric Motor and Trail Cars.

Builders of Brill No. 21 Truck with Solid Forged Frame, and "Eureka" Maximum Traction Pivotal Truck.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.,
WORCESTER, MASS.

BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Scranton.

Patented.

No. 11 DOUBLE GROOVE PONY INSULATOR
HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

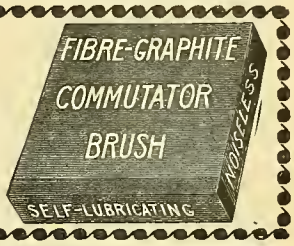
"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

HEMINGRAY GLASS CO., Covington, Ky.
FACTORIES, MUNCIE, IND.

Manufacturers and Dealers PARTRICK & CARTER CO. 125 So. 2nd St. PHILADA. PA. ELECTRICAL HOUSE GOODS.

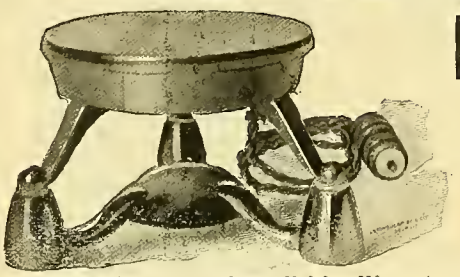
No Sparking Under Varying Load,
No Wear on the Commutator.
90% PURE GRAPHITE.

Holmes Fibre-Graphite Mfg. Co.,
Station Z, Philadelphia.
WRITE FOR PRICE LIST.



Jewell Belting Co.,
TANNERS OF
OAK BELTING LEATHER,
Manufacturers of....
High Grade Oak Belting,
HARTFORD, CONN.

THE "DETROIT"
ELECTRIC DISK STOVE!



Excels all others for Cooking, Melting Wax, etc. Made for all incandescent circuits, "direct or alternating." Uses 2¼ to 3 amperes at 110 volts. 6¼ inches diameter—over 33 square inches heating surface. Latest improvements; safe, reliable, durable, efficient and repairable. Gets hot quick—no matches, smoke, fire or danger. Boils the teakettle or the coffee pot, stews oysters, fries meat and potatoes; does all kinds of light cooking. Valuable for the lunch counter and hundreds of other places. Send for Circulars. We have the best Air Heaters, Ovens, Laundry Irons, Tailor's "Goose," Water Heaters, Curling Iron Heaters, Etc. Dealers sell our goods quickly because they are O. K. and prices are right. Agents wanted in territory not taken.

DETROIT ELECTRIC HEATING CO.,
132 SHELBY STREET, DETROIT, MICH.

WEATHERPROOF WIRE.

—AGENCIES:—
Western Electric Co., New York.
Electric Appliance Co., Chicago.
Pettingell Andrews Co., Boston.
Electrical Engineering Co., Minneapolis.
St. Louis Electrical Supply Co., St. Louis.
The Bradford Belting Co., Cincinnati.

Phillips Insulated Wire Co.,
Office and Factory: PAWTUCKET, R. I.

WANTED.

An electric light and gas superintendent now in charge of a combined plant, will be open for engagement May 1st. Reference from present owner. Address, **B. S. Reynolds**, 1615 Kentucky street, Louisiana, Mo.

WANTED.

One second-hand 100 k. w. 500 volt power generator, and one 200 to 270 k. w. 500 volt power generator, also one 1,000 volt 60 cycle alternator of 100 k. w. capacity; thirty 1,200 c. p. double carbon T.-H. arc lamps. Address "**K**," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

An electrical engineer who has been very successful in bringing non-paying light and railway plants on a paying basis will be open to engagement May 1st. Would accept management of plant either on fair salary, percentage of profits under my management or other equitable arrangement. Address **LIGHT & RAILWAY**, care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

A thoroughly competent electrical engineer, one having had elevator experience preferred. Answer, giving reference, experience and salary required. Address "**J. V.**," care WESTERN ELECTRICIAN, 108 Times Bldg., New York.

WANTED.

ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

HODGE, WALSH & LORING,
531 Delaware, KANSAS CITY Mo.

FOR SALE.

20,000 SOLDERING STICKS for sale cheap. Send 10 cents for sample stick by mail. **R. W. SCHMELZ**, Jacksonville, Florida.

FOR SALE.

Two 30 k. w. 1,000 volt compound wound General Electric alternators, latest type, with exciters and instruments, good as new and very cheap. One 60 k. w. standard alternator, 1,000 or 2,000 volt, with exciter and instruments, in fine condition. A bargain. **V. J. MAYO.**
100 N. Clinton St., Chicago, Ill.

FOR SALE—CHEAP.

Six 25 amp. 110 volt dynamos, compound wound.
Six five horse power motors, any voltage.
Twelve amperemeters.
Twelve voltmeters. **Write for prices.**

HOLMES, PYOTT & CO.,
13 N. Jefferson St., Chicago.

THE ELECTRICAL EXCHANGE,

166-174 S. CLINTON ST., CHICAGO.

Long-Distance Tel. 744 Express.

WRITE FOR PRICES.

The Brady Mast Arms.

T. H. Brady, New Britain,, Conn., U. S. A.,

Manufacturer of Mast Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for Descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
EST. 1892. 31 W. Quincy St., Chicago, Ill.

Keystone Electrical Instrument Co.,
9th St. & Montgomery Ave.,
PHILADELPHIA.
Switchboard Instruments
For Central Stations and Isolated Plants.
New York, 15 Cortlandt Street.
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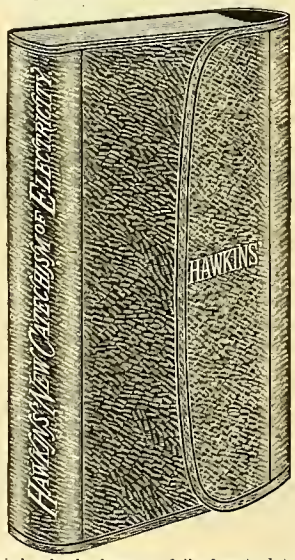

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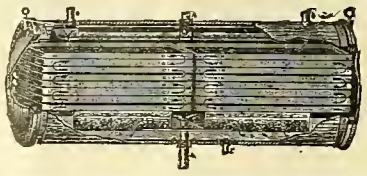

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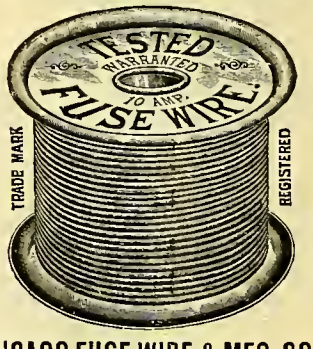

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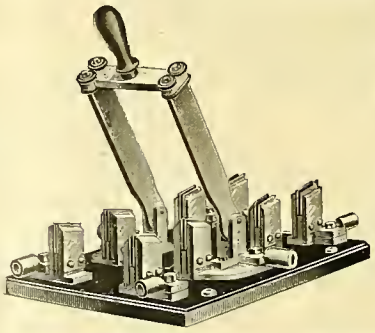

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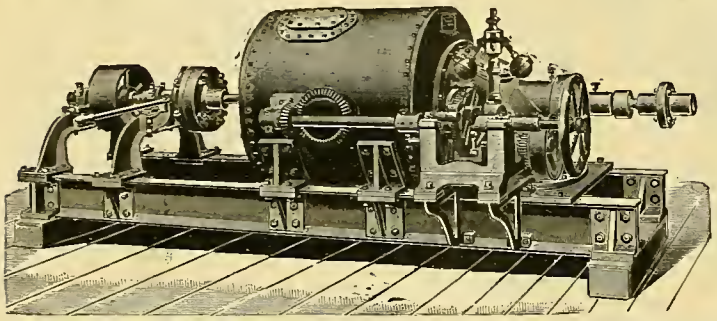

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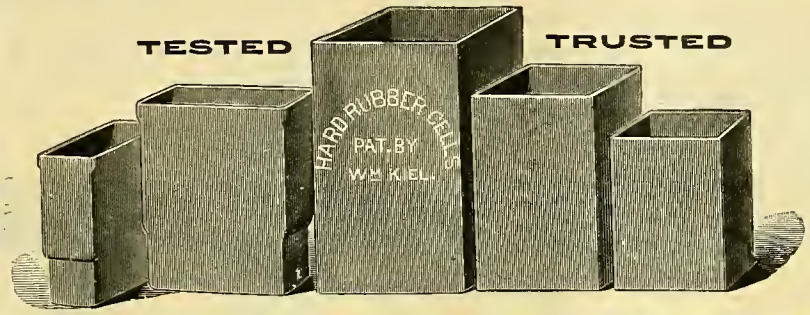

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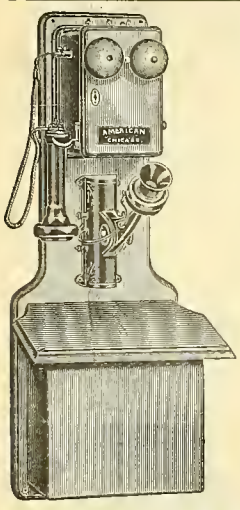

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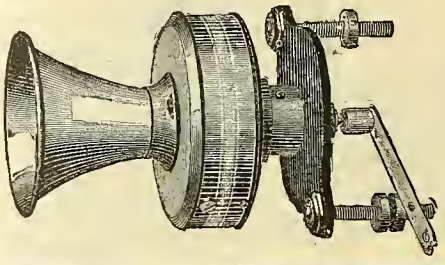

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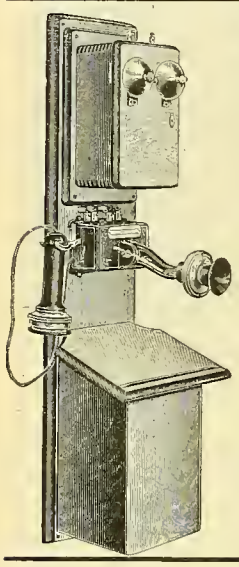

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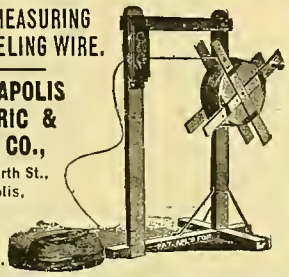

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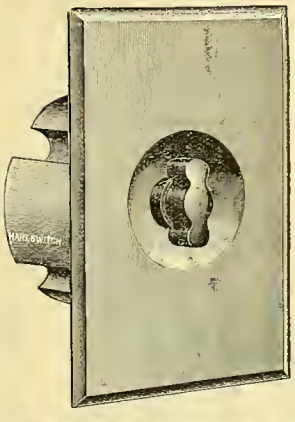

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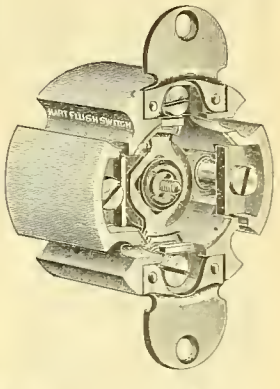

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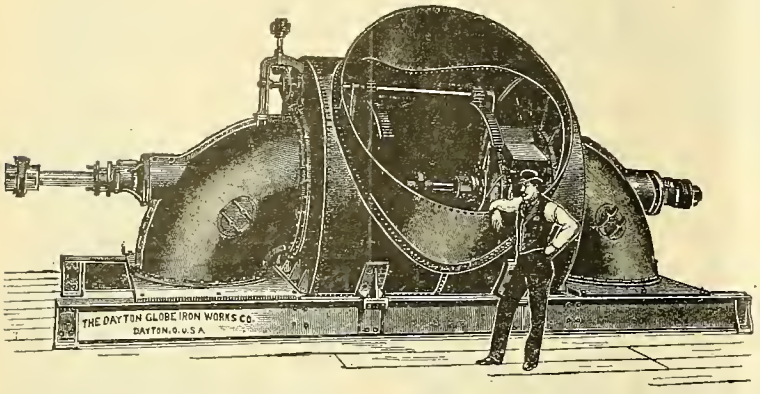

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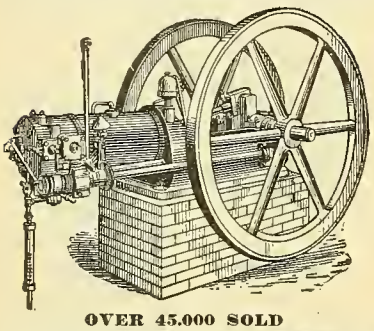

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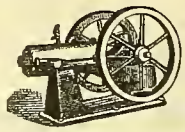

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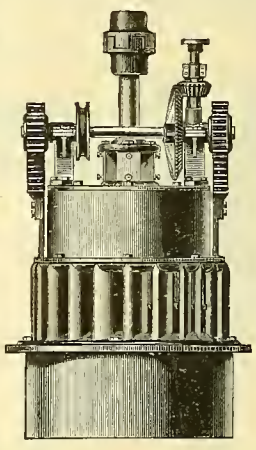

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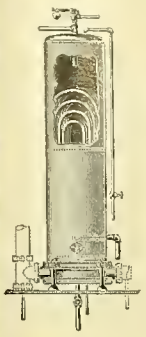

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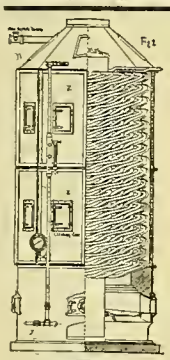

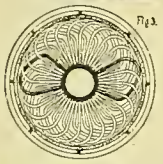

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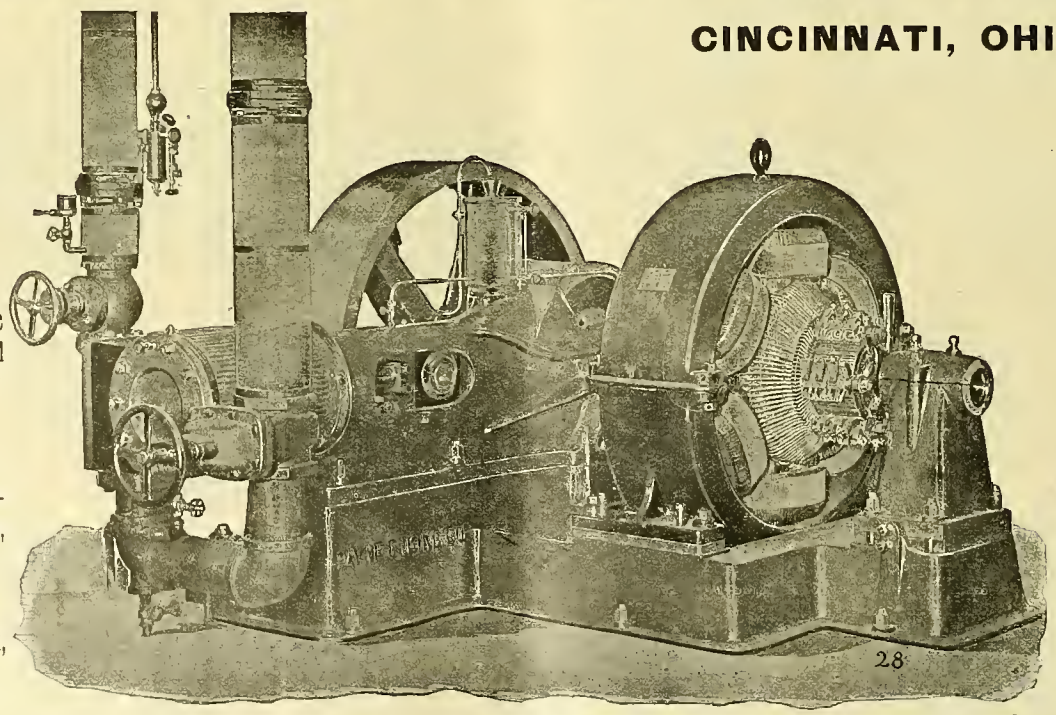

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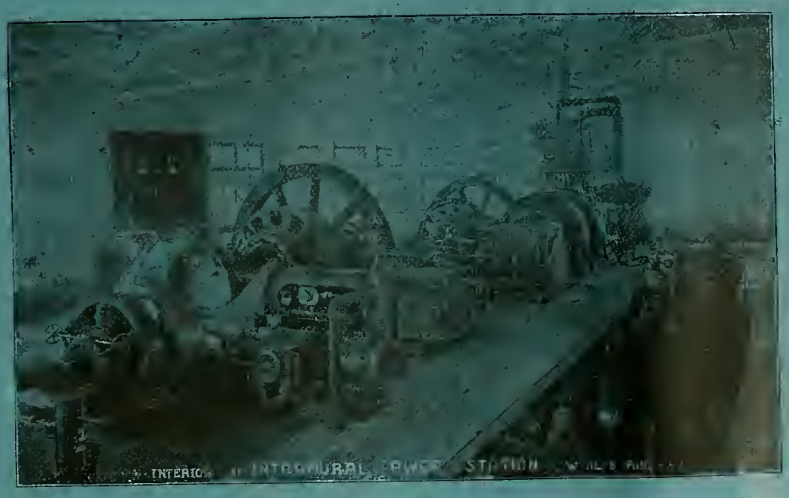

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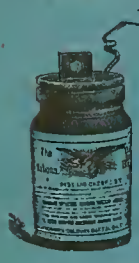

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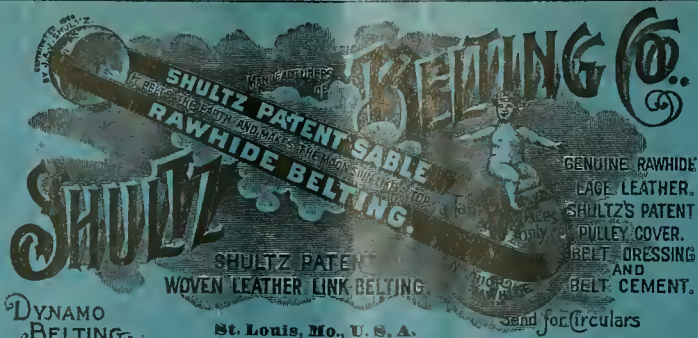

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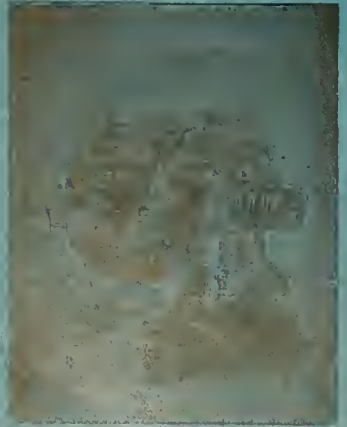

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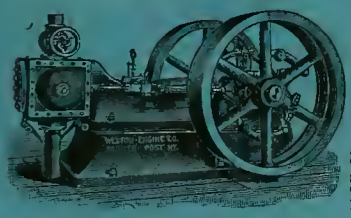

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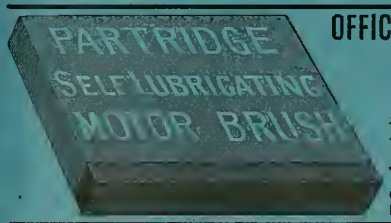

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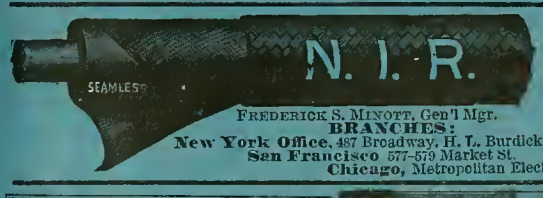

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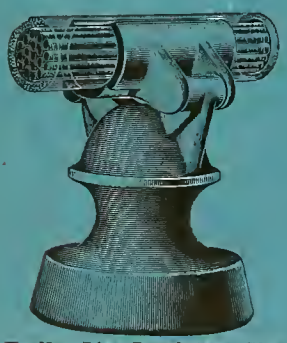

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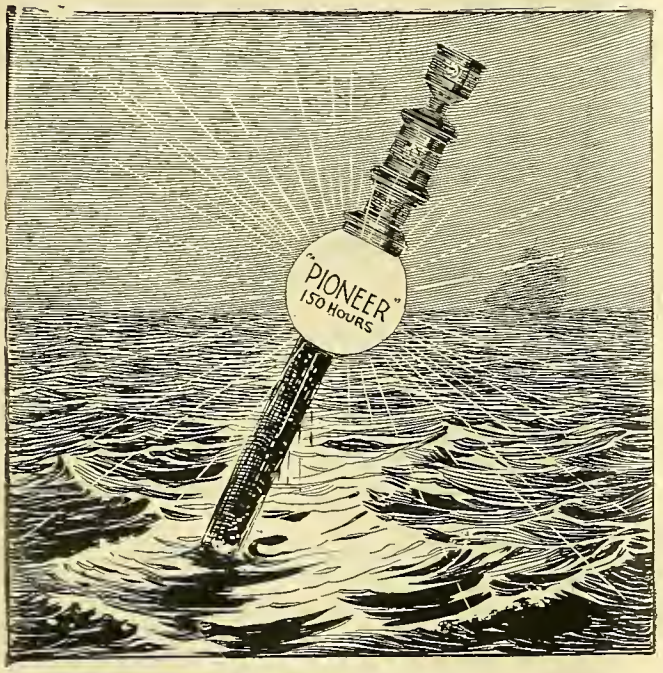

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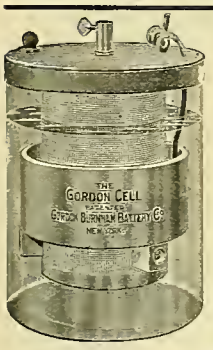

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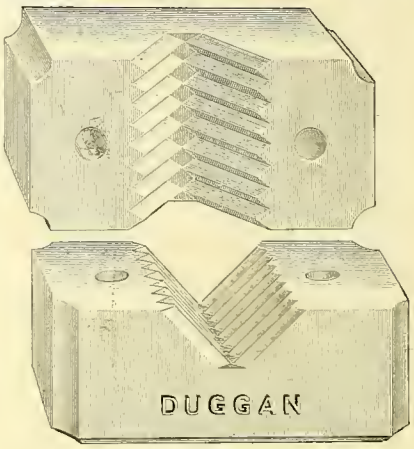

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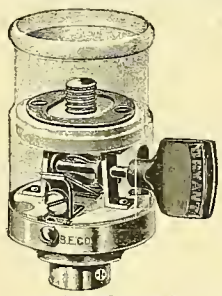

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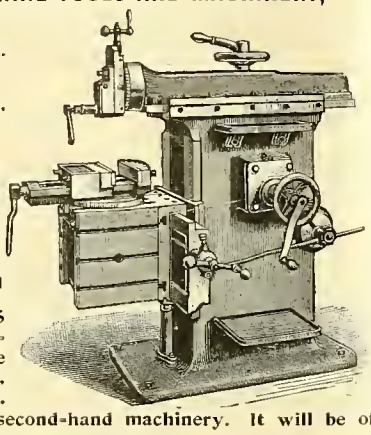

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Central Electric Co.
Commercial El. Supply Co.
Edison Mfg. Co.
Perkins Elec. Switch Mfg.Co.
Spring Park Laboratory.
Swett & Lewis.

Cross-Arms, Pins and Brackets.
Brady, T. H.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.

Cut-Outs and Switches.
Automatic Cir. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Gilmore El. & Mfg. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Elec. Co.
Imperial Porcelain Works.
Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Reynolds, S. K.
Westinghouse El. & Mfg. Co.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Brush Electric Co.
Bullock Elec. Mfg. Co
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Northern Electl. Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fuel Economizer Co.

Electric Heaters.
American El. Heating Corp.
Detroit Elec. Heating Co.
Johns, H. W., Mfg. Co.

Electric Meters.
American El. Meter Co.

Electric Railways.
Brush Electric Co.
General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Foree.
Bryan & Humphrey.
McRae, A. L.
Patitz, A. M.
Pratt, Chas. A.

Electrical Instruments.
Automatic Cir. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Electrical Specialties.
Automatic Cir. Breaker Co
Carlisle & Finch.
Central Electric Co.
Commercial El. Supply Co.
Metropolitan Electric Co.
Peru Elec. Mfg. Co.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Colburn El. Mfg. Co.
General Electric Co.

Engines, Gas.
Otto Gas Engine Wks.
Van Duzen Gas & Gso. En. Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Philadelphia Eng. Works.
Weston Engine Co.

Fan Outfits.
Bates & Bro., D. L.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Hunter Fan & Motor Co.
Interior Conduit & Ins. Co.
Western Electric Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. B.

Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fixtures, El. & Comb'n.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg.Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Bogart, A. L.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Genor & Colburn.
Hill, W. S. Elec. Co.
Hodge, Walsh & Loring.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Pacific Electric Co.
Partrick & Carter Co.
Peru Elec. Mfg. Co.
Sioux City Brass Works.
Western Electric Co.

Globes and Electrical Glassware.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Hemingray Glass Co
Phoenix Glass Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Hard Rubber Goods.
Butler Bard Ruhber Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Empire China Works.
Gilmore El. & Mfg. Co.
Hemingray Glass Co.
Hodge, Walsh & Loring.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Locke, Fred. M.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Alternating.
Puritan Electric Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Robertson & Sons, J. L.
Stilwell-Bierce Smith-Vaile.

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
Keystone Electric Co.
Metropolitan Electric Co.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Hart, C. S.
Lindsley Bros.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Tagatz, H. A.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Imperial Porcelain Works.
Peru Elec. Mfg. Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Reels, Wire.
Minneapolis El. & Cons. Co.

Refiners.
Swarts Metal Refining Co.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.

Rheostats.
Am. Heating Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Westinghouse El. & Mfg. Co.

Search Lights.
Carlisle & Finch.

Second-Hand Machin'y.
Electrical Exchange, The.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Steam Gauges.
Robertson & Sons, J. L.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Farr Tel. & Coos. Sup. Co.
Kusel, D. A. Tel. Mfg. Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
Washburn & Moen Mfg. Co.

Wire Joints.
American Elec. Fuse Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Edison Mfg. Co.
Queen & Co.
Spring Park Laboratory.
Swett & Lewis.

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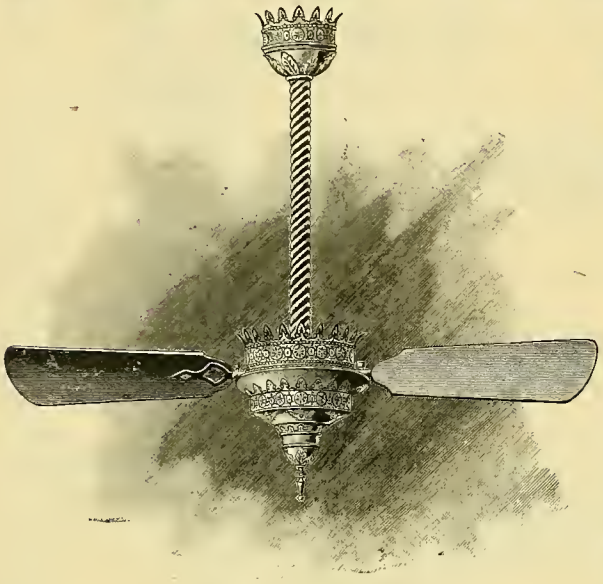
DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

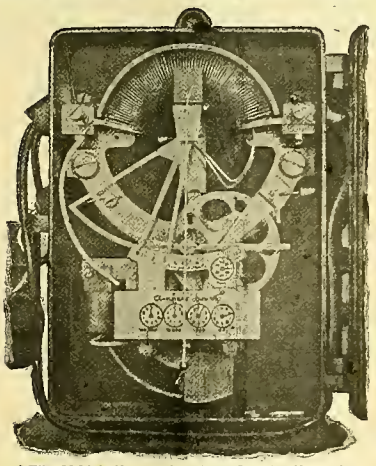
SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



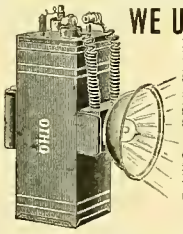
3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

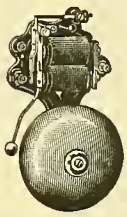
It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
88 Medical Batteries....	3.95
Electric Bells, finest...	.25
Dry Batteries, best.....	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells.....	.50

Agents Wanted.
Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.



BELLS
—AND—
PUSH BUTTONS.
Exclusive Features.
Send for New Catalogue.
Huebel & Manger,
MANUFACTURERS,
Style F. 290 Graham St., Brooklyn, N. Y.

BUCKEYE
INCANDESCENT LAMPS.

QUALITY UNEQUALED
FACTORY PRODUCTION TRIPLED.

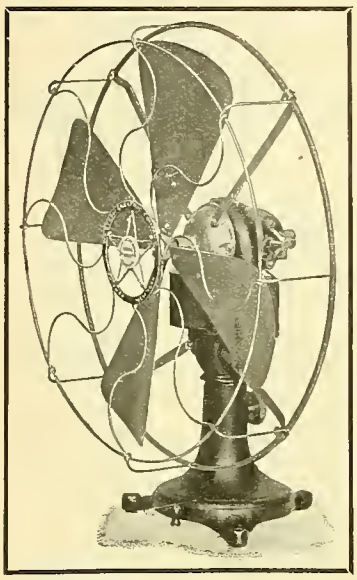
Monadnock Building, Chicago. THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.

DYNAMOS AND MOTORS 1 to 30 H.P.

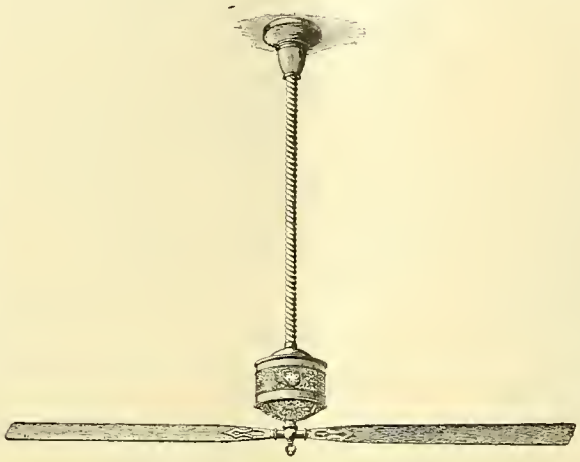
REPAIRS!

CHICAGO ARMATURE CO.,
14 & 16 N. CANAL ST. CHICAGO.

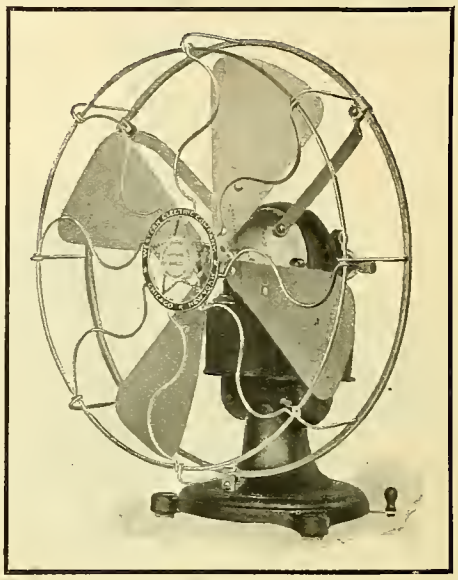
Standard Fans for 1897.



Desk Fan—16 inch.



Ceiling Fan.



Desk Fan—12 inch.

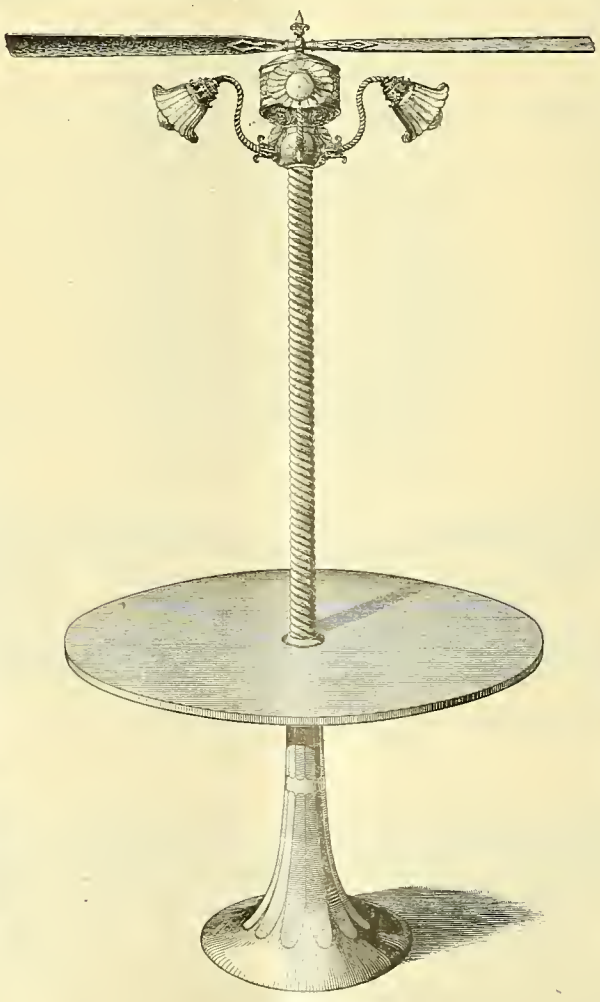
Western Electric Company.

==== Chicago.
==New York.

110 Volts,

220 Volts,

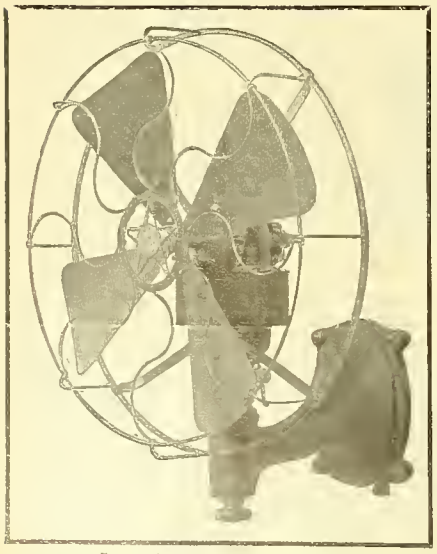
550 Volts.



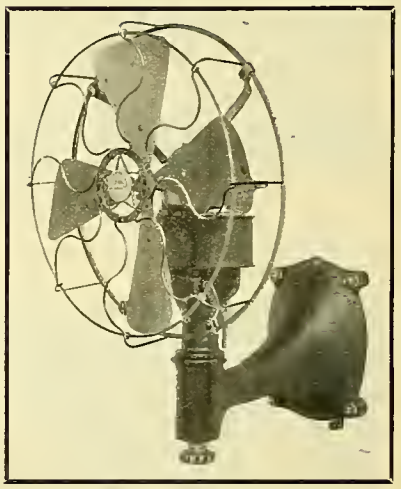
Column Fan.

Three Speeds Desk and Bracket Fans.

Two Speeds for Column and Ceiling Fans.

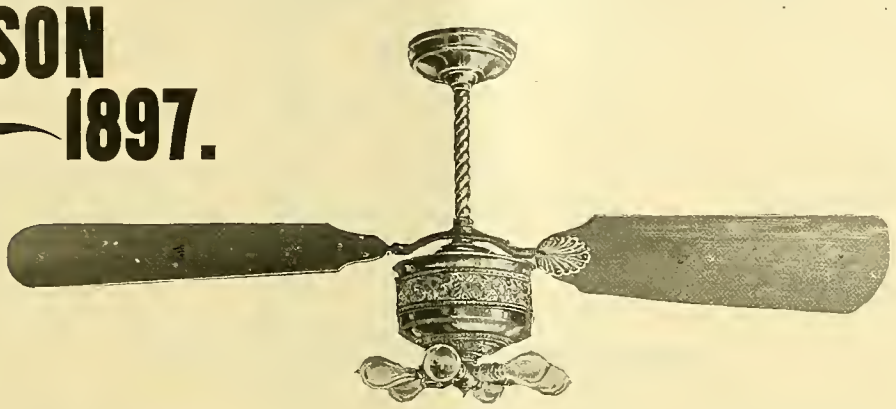


Bracket Fan—16-inch.



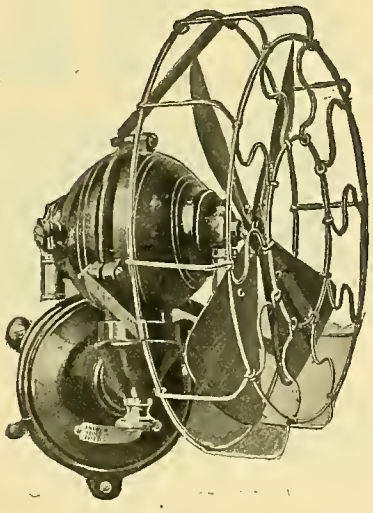
Bracket Fan—12-inch.

SEASON 1897.



The LUNDELL FAN MOTORS ARE THE STANDARD

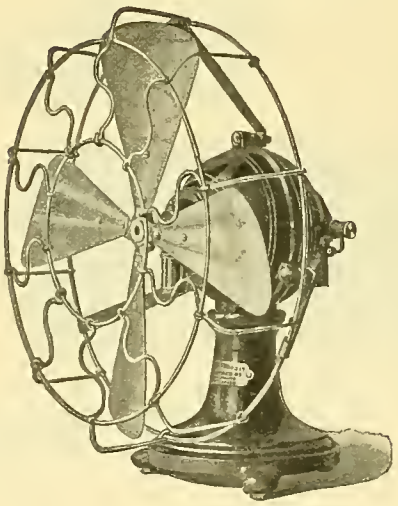
THOUSANDS IN USE



Illustrated Catalogue

...UPON...

APPLICATION.



Interior Conduit & Insulation Co.,

GENERAL OFFICES AND WORKS:

527 W. 34th St., NEW YORK, N. Y.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

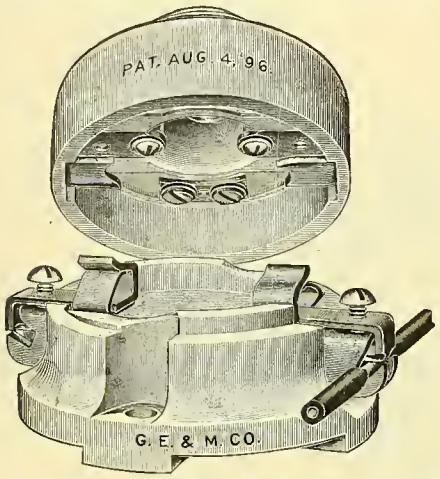
THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,
FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



'96 LEADS.

WHY?

BECAUSE:

1st—Has perfect contact without marring softest wire.
2nd—Line wire is held by clamp instead of screw points.
3rd—It is easy to take apart; no screw driver, only a quarter turn.
4th—Can use long fuse.
5th—All that use them say so.

Write for Prices on Fuse Blocks, Etc.

GILMORE ELEC. & MFG. CO., North Easton, Mass

HERE IS THE

"GLAD HAND"

OPAL, RUBY, FLESH TINT.

DAVIS INDICATING GLOBE,

COVERING INCANDESCENT LAMP.
(PATENTED)
MANUFACTURED ONLY BY

RUBY, Clear Letters.

THE PHOENIX GLASS CO.,

Manufacturers of Electric and Gas Globes, Shades, Etc.

RUBY, Clear Letters.

42 Murray Street, New York.

Length of Davis Globe, 11 Inches,
To Fit 3¼-inch Holder.

WRITE US FOR PRICES AND DISCOUNT.

RUBY, Clear Letters.

USEFUL! PRACTICAL!! PROFITABLE!!!

"Ad." Studio

OF THE

COMMERCIAL ELECTRICAL SUPPLY CO.,

St. Louis.

INTERIOR CONDUIT :: IRON AND BRASS ARMORED — IT CAN'T BE BEAT AND YOU KNOW IT!

FANS! FANS! — GREAT SCOTT! YOU DON'T KNOW THIS LINE — TRY OUR PRICES!

AND THOSE SOCKETS! WE'RE NOT SOLD OUT YET

CARBONS, IMPORTED — DOMESTIC — AND WE'RE NOW AGENTS FOR AMERICAN MICA — TRY US

LOOK AT THOSE "LINES"!

P. S. Couldn't help it—could you?

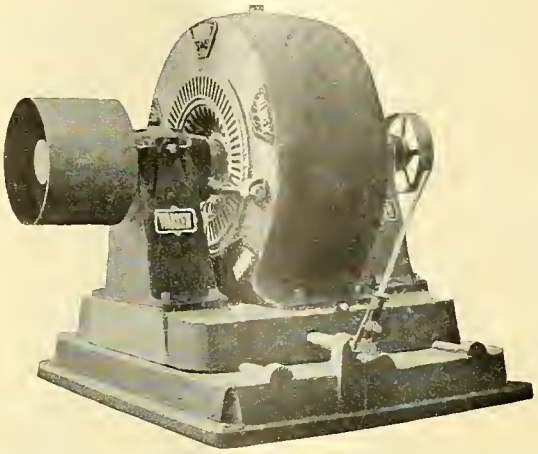
THE WARREN ALTERNATOR.

A DYNAMO without Collector Rings, or Commutator; without Brushes, without Moving Wires, without liability to "burn-out."

MASSIVE AND HEAVY, BUT EXTREMELY COMPACT.

Made for continuous runs without attention and proportioned to run up to an enormous overload without wasting energy in heating any part.

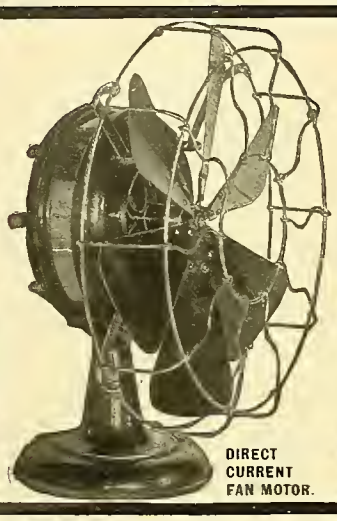
NOISELESS IN OPERATION.
A MONEY EARNER.



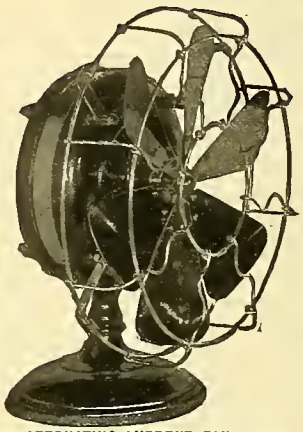
THE EMBODIMENT OF SIMPLICITY AND DURABILITY.

THE
MODERN DYNAMO
FOR CENTRAL STATION WORK.

Warren Electric Manufacturing Company,
SANDUSKY, OHIO.



DIRECT CURRENT FAN MOTOR.

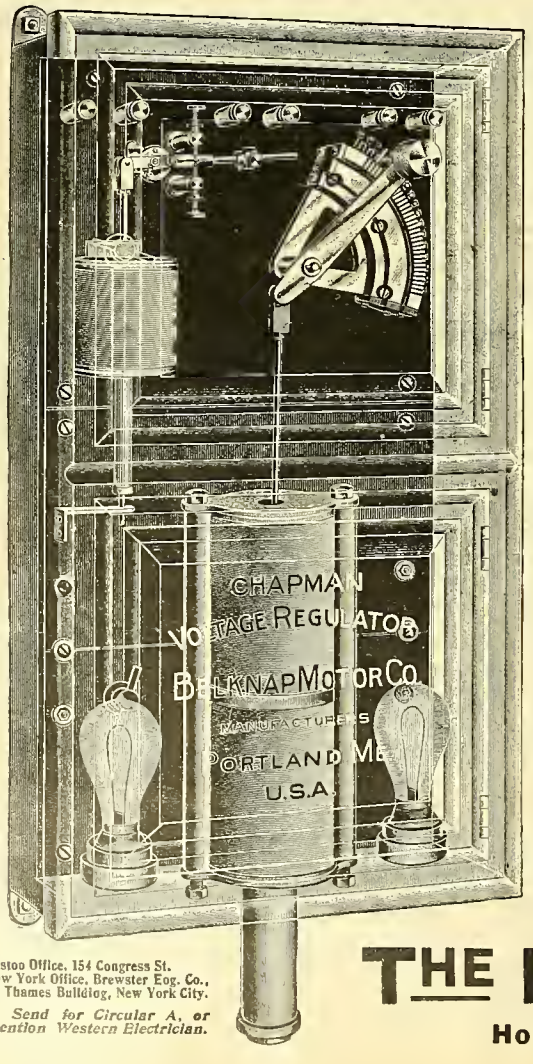


ALTERNATING CURRENT FAN MOTOR.

G E '97 MODEL.
FAN MOTORS
FOR ALTERNATING CURRENT
—AND—
DIRECT CURRENT CIRCUITS.

GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

SALES OFFICES IN ALL LARGE CITIES IN THE UNITED STATES.



Steady Lights from Unsteady Power.

The Chapman Voltage Regulator

Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

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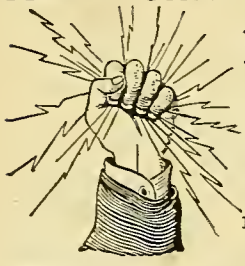

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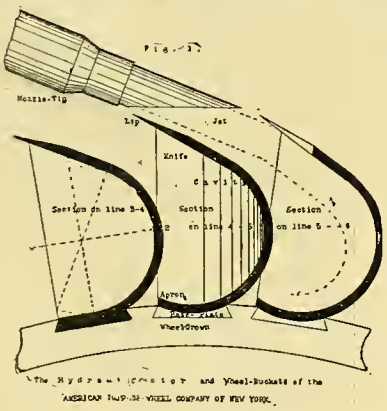

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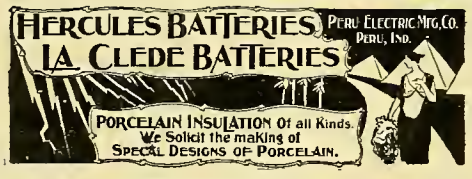

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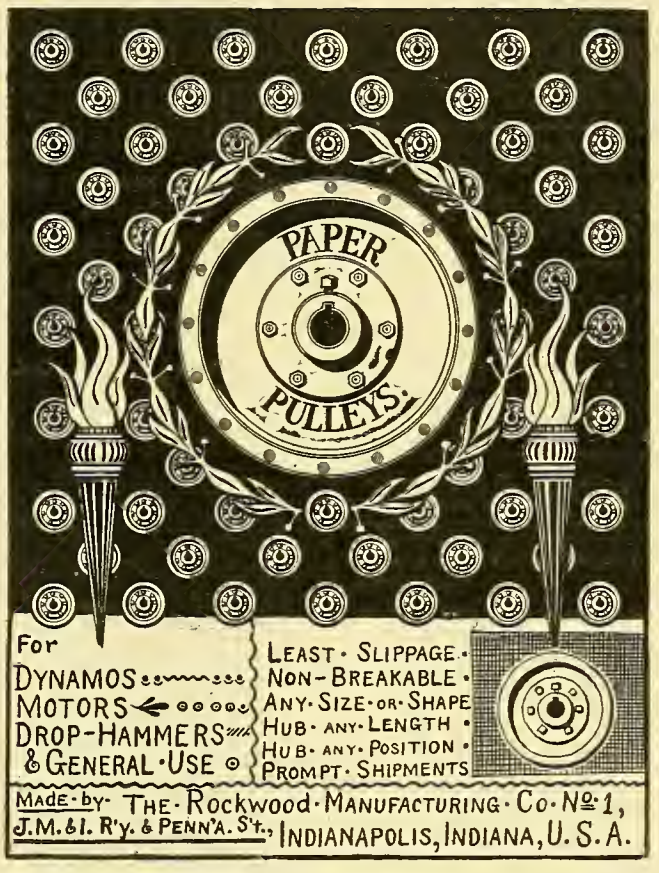

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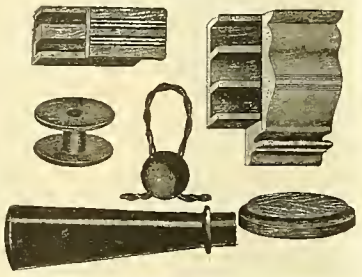

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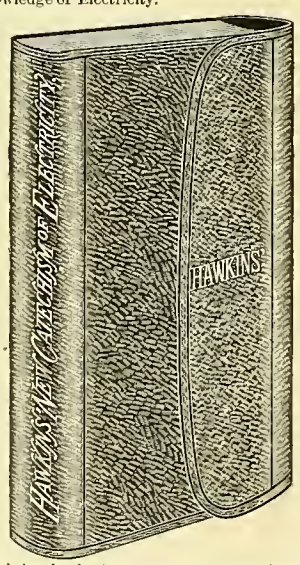

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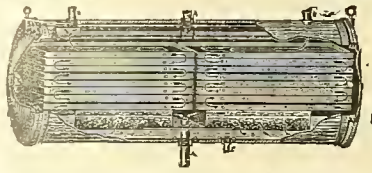

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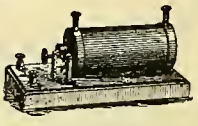

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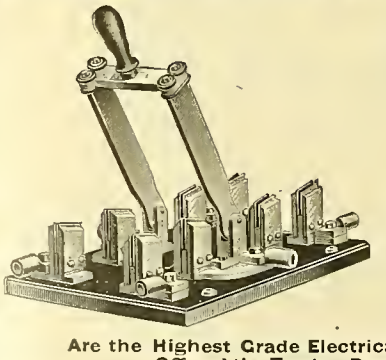

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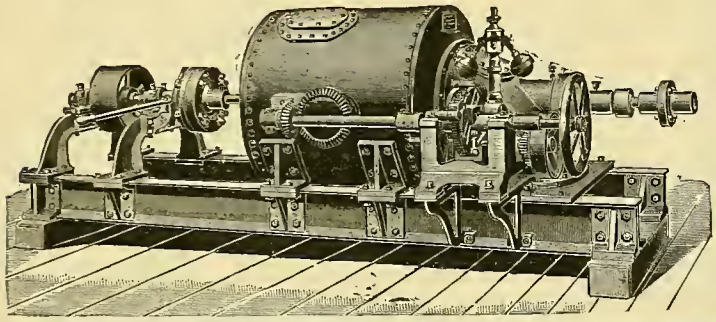

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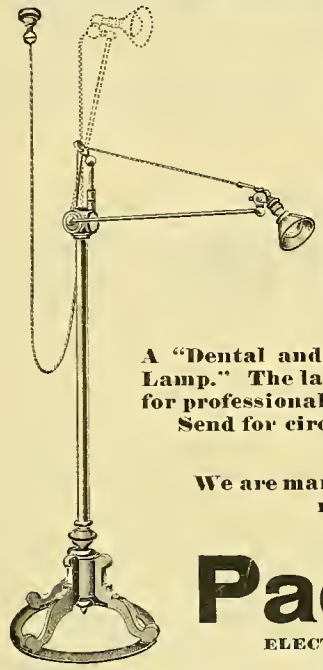

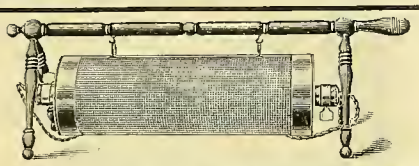

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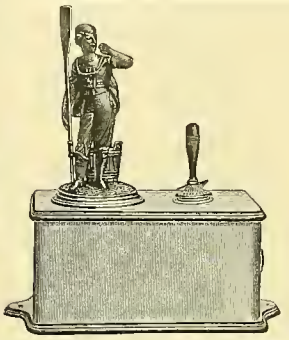

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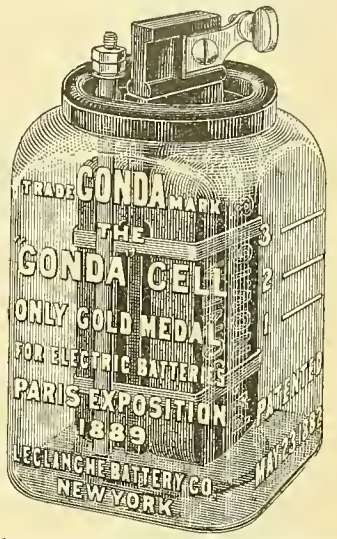

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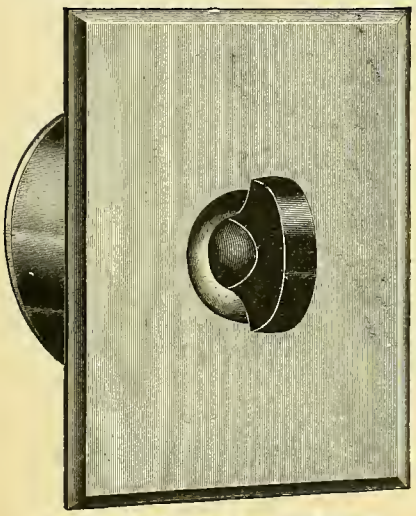

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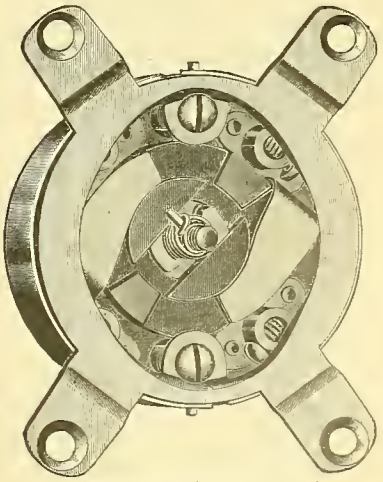
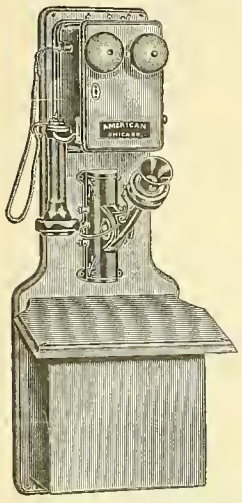


Switch with Plate Removed.



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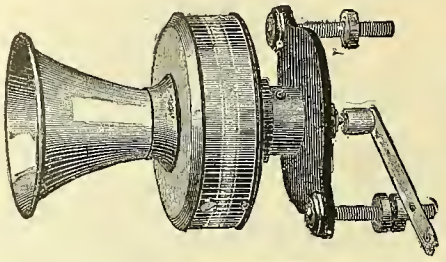

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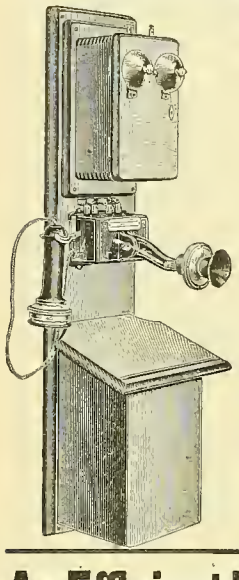

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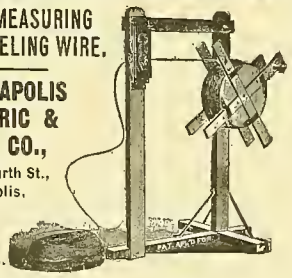

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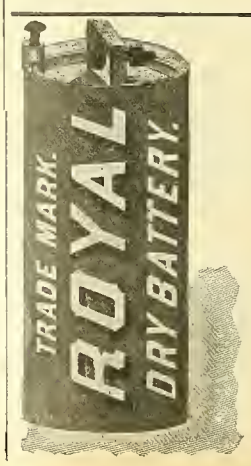

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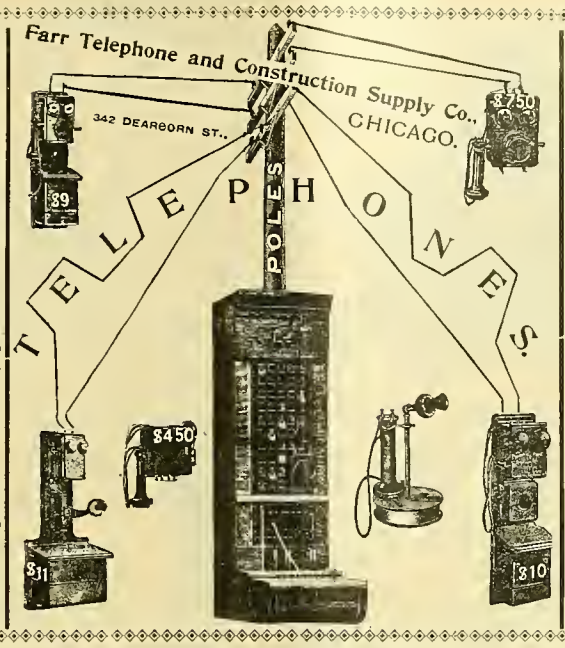

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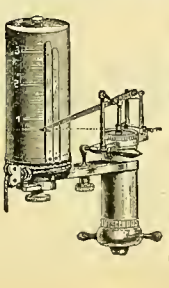

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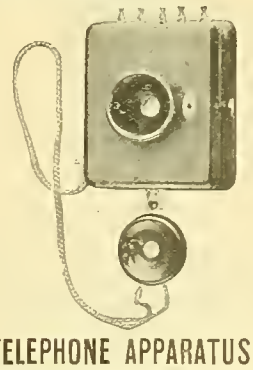

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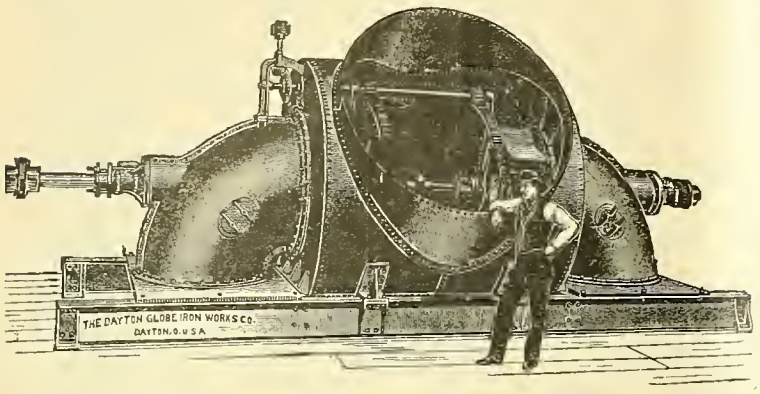

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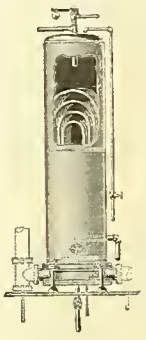

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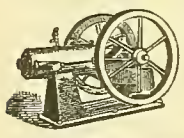

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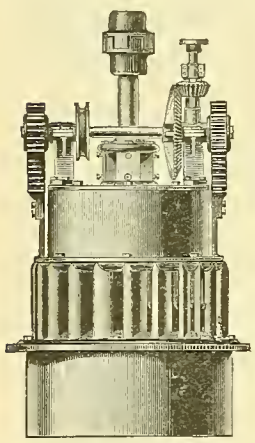

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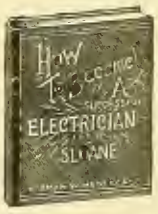

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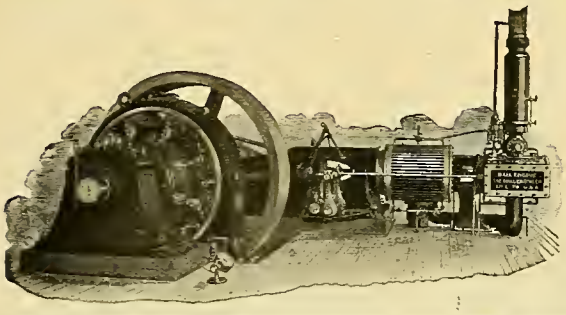

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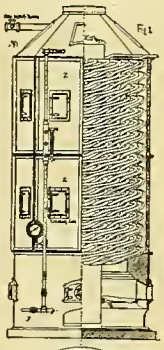

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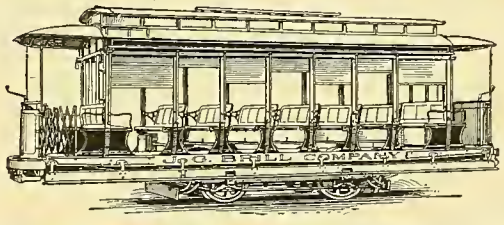

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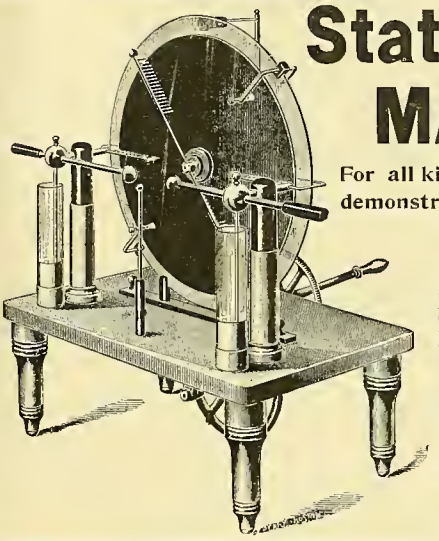

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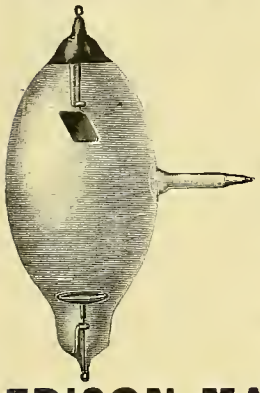

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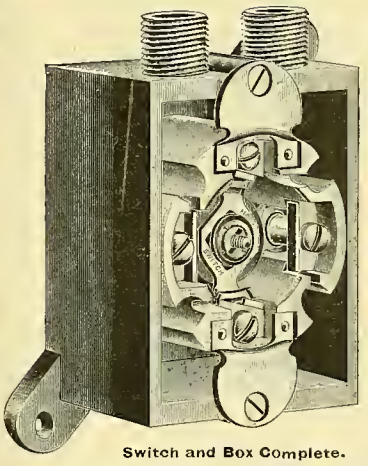

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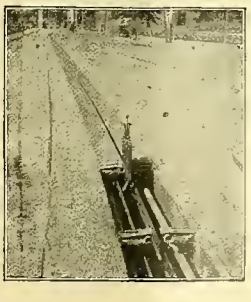

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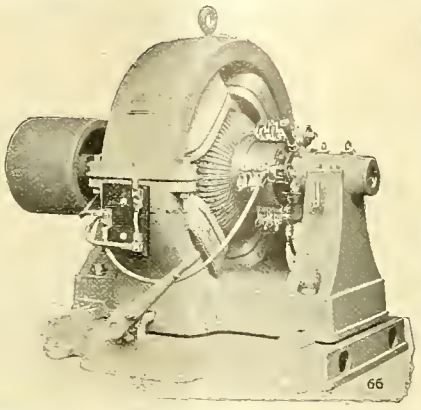

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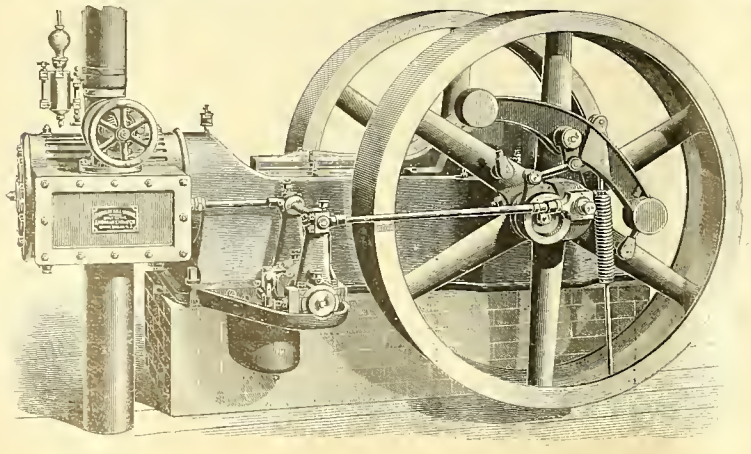

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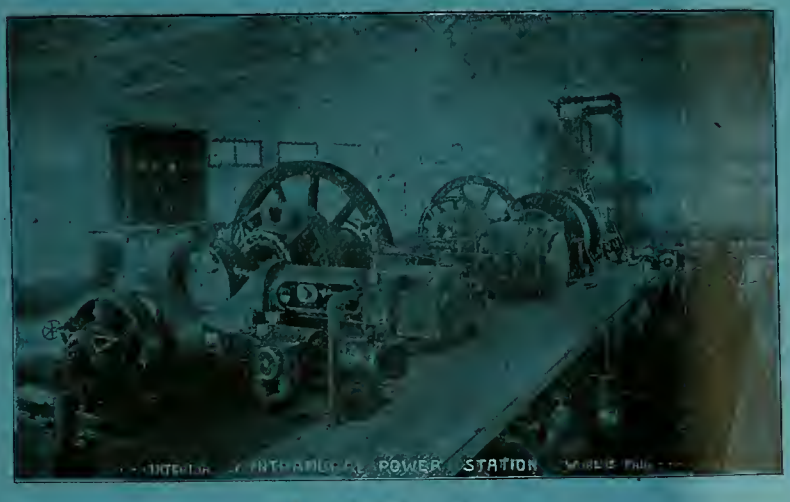

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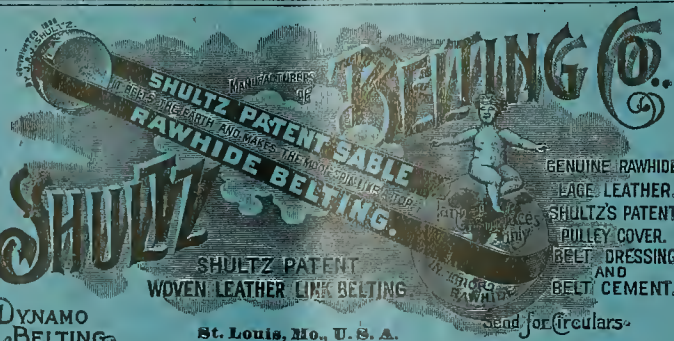

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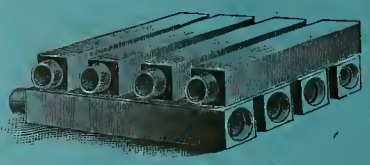

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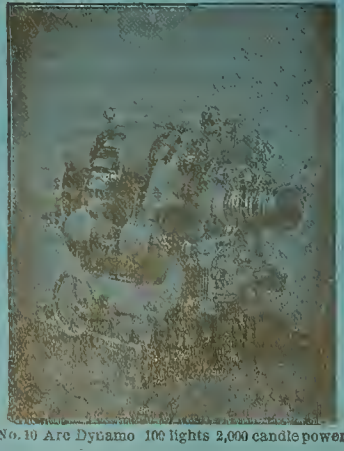

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Vol. XX. CHICAGO, MAY 1, 1897. No. 18

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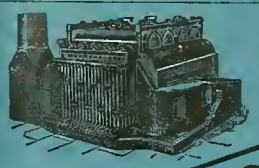

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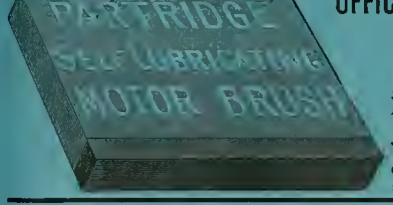

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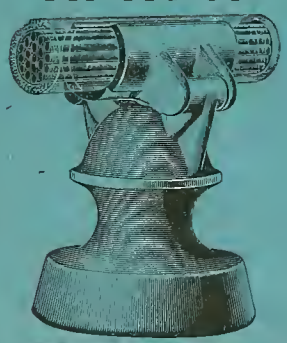

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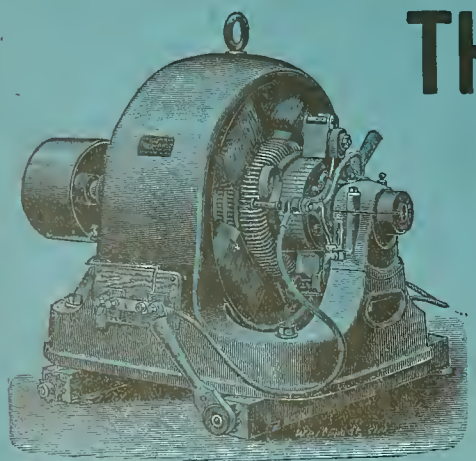

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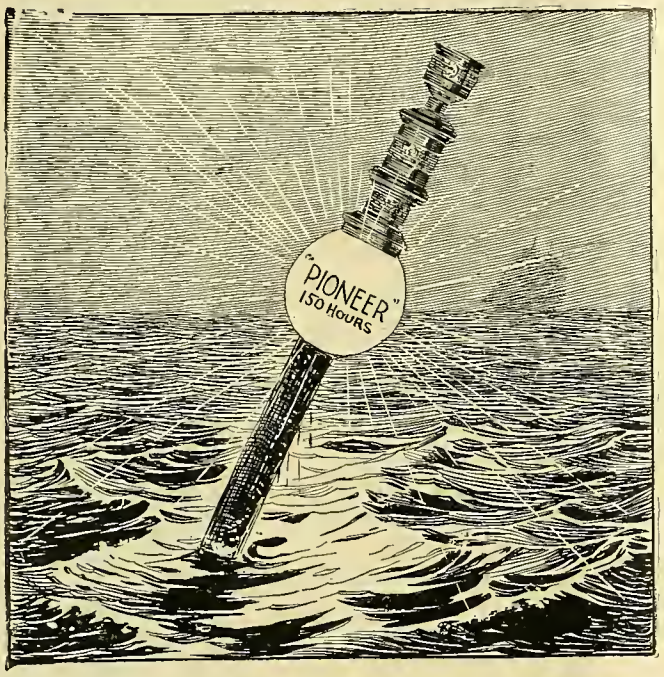

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AMERICAN CARBON CO.'S Plain and Coated

CARBONS FOR SERIES ARC LIGHTING.

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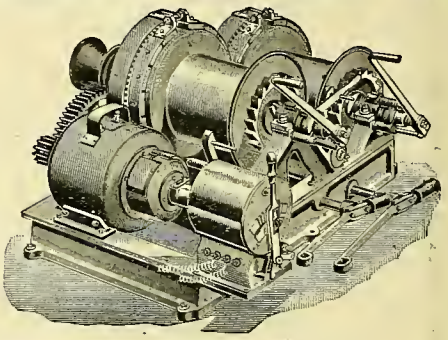

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Special Direct Current Motors for All Classes of Work.

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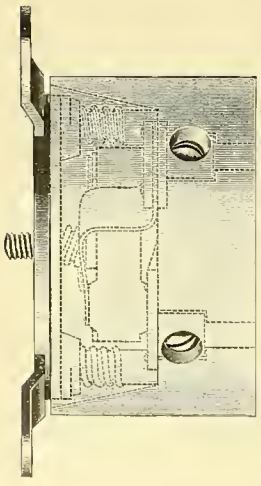
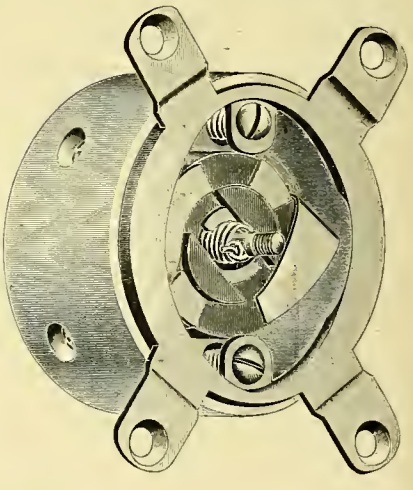


PERKINS FLUSH SWITCHES



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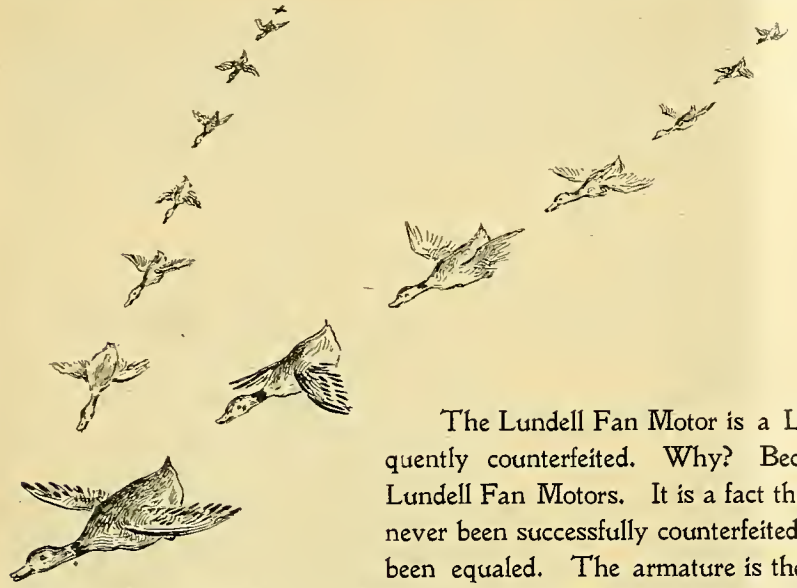

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Set the pace; others strive to keep apace. . . . .

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MADE FOR FROM 50 TO 120 VOLTS.
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Cables, Electric (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Metropolitan Electric Co.
Moore, Alfred F.
National Cond & Cable Co.
New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Carbons, Points & Plates.
Central Electric Co.
Chicago Edison Co.
Chicago General Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partridge Carbon Co.
Reisinger, Hugo.

Cars.
Brill Co., J. G.

Compound.
Central Electric Co.
California Asphalt Co.
Commercial El. Supply Co.
Electric Appliance Co.
Johns Mfg. Co., H. W.
McLennan & Co., K.
Okonite Co.
Standard Paint Co.

Condnits.
Armorite Interior Cond Co.
Camp Co., H. B.
Central Electric Co.
Commercial El. Supply Co.
Conn. Pipe Mfg. Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
National Cond. & Cable Co
Williamsport Wdn. Pipe Co.

Construction & Repairs.
Bullock Elec. Mfg. Co.
Chicago Armature Co.
Chicago Edison Co.
Davis, L. W.
Electrical Exchange, The.
Ft. Wayne Elec. Corporation.
Hodge, Walsh & Loring.
Keystone Electric Co.
Warren Electric Mfg. Co.

Contractors and Electric Light Plants.
Ahlm-Edwards El. Co.
Arnold El. Pr. Station Co.
Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
Bullock Elec. Mfg. Co.
Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
Keystone Electric Co.
Northern Electl. Mfg. Co.
Patitz, A. M.
Peoples Electric Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse Elec & Mfg Co.

Copper.
Besly & Co., Chas. H.
Mansfield Temp. Copper Co.

Copper Wires.
American Electrical Works.
Besly & Co., Chas H.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Cordage.
Samson Cordage Wks.

Correspondence Schools.
Int. Correspond. Schools.

Crookes' Tubes.
Central Electric Co.
Commercial El. Supply Co.
Edison Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Spring Park Laboratory.
Swett & Lewis.

Cross-Arms, Pins and Brackets.
Brady, T. H.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.

Cut-Outs and Switches.
Automatic Cir. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Glimore El. & Mfg. Co.
Hart & Hegeman Mfg. Co.
Imperial Porcelain Works.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Reynolds, S. K.
Westinghouse El. & Mfg. Co.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Brush Electric Co.
Bullock Elec. Mfg. Co
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Northern Electl. Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fuel Economizer Co.

Electric Heaters.
American El. Heating Corp.
Detroit Elec. Heating Co.
Johns, H. W., Mfg. Co.

Electric Meters.
American El. Meter Co.

Electric Railways.
Brush Electric Co.
General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Foree.
Bryan & Humphrey.
McRae, A. L.
Patitz, A. M.
Pratt. Chas. A.

Electrical Instruments.
Automatic Cir. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Electrical Specialties.
Automatic Cir. Breaker Co
Carlisle & Finch.
Central Electric Co.
Commercial El. Supply Co.
Metropolitan Electric Co.
Peru Elec. Mfg. Co.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
Colburn El. Mfg. Co.
General Electric Co.

Engines, Gas.
Otto Gas Engine Wks.
Van Duzen Gas & Geo. En. Co.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Philadelphia Eng. Works.

Fan Outfits.
Bates & Bro., D. L.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Hunter Fan & Motor Co.
Interior Conduit & Ins. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Soo, I. B.

Fibre.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fixtures, El. & Comb'n.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Bogart, A. L.

Gears.
Besly & Co., Chas. H

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Gener & Colburn.
Hodge, Walsh & Loring.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Hemingray Glass Co.
Phoenix Glass Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Empire China Works.
Glimore El. & Mfg. Co.
Hemingray Glass Co.
Hodge, Walsh & Loring.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Locke, Fred. M.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Alternating.
Puritan Electric Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Robertson & Sons, J. L.
Stilwell-Bierce Smith-Valle.

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Colburn El. Mfg. Co.
Commercial El. Supply Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
Keystone Electric Co.
Metropolitan Electric Co.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Hart, C. S.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Tagatz, H. A.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Imperial Porcelain Works.
Peru Elec. Mfg. Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.

Rheostats.
Am. Heating Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Westinghouse El. & Mfg. Co.

Search Lights.
Carlisle & Finch.

Second-Hand Machin'y.
Chicago Armature Co.
Electrical Exchange, The.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co
Whitney Elec. Inst. Co.

Steam Gauges.
Robertson & Sons, J. L.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Farr Tel. & Cons. Sup. Co.
Kusel, D. A. Tel. Mfg Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.

Transformers.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

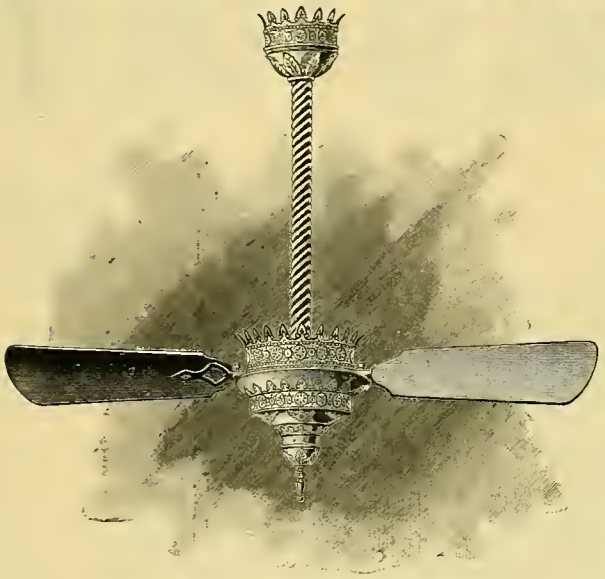
Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
Washburn & Moen Mfg. Co.

Wire Joints.
American Elec. Fuse Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Edison Mfg. Co.
Queen & Co.
Spring Park Laboratory.
Swett & Lewis.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

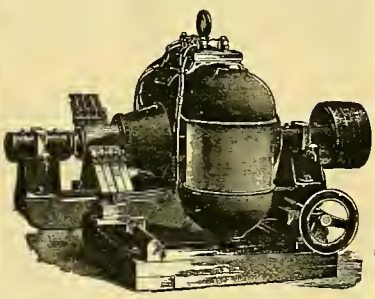
OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

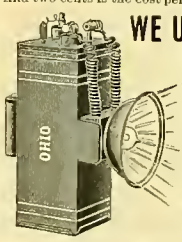
DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

DALLETT
Electric Motors and Generators,
MANUFACTURED BY
THOS. H. DALLETT & CO.,
York St. and Sedgley Ave.,
PHILADELPHIA, PA.



Portable Electric Drills,
Starting Boxes and
Controllers,
Automatic Switches. . . . . .
Flexible Insulated Couplings.

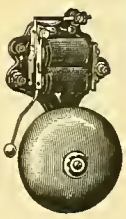
It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
$8 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.50

Agents Wanted.
Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.



BELLS
—AND—
PUSH BUTTONS.
Exclusive Features.
Send for New Catalogue.
Huebel & Manger,
MANUFACTURERS,
290 Graham St., Brooklyn, N.Y.
Style F.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

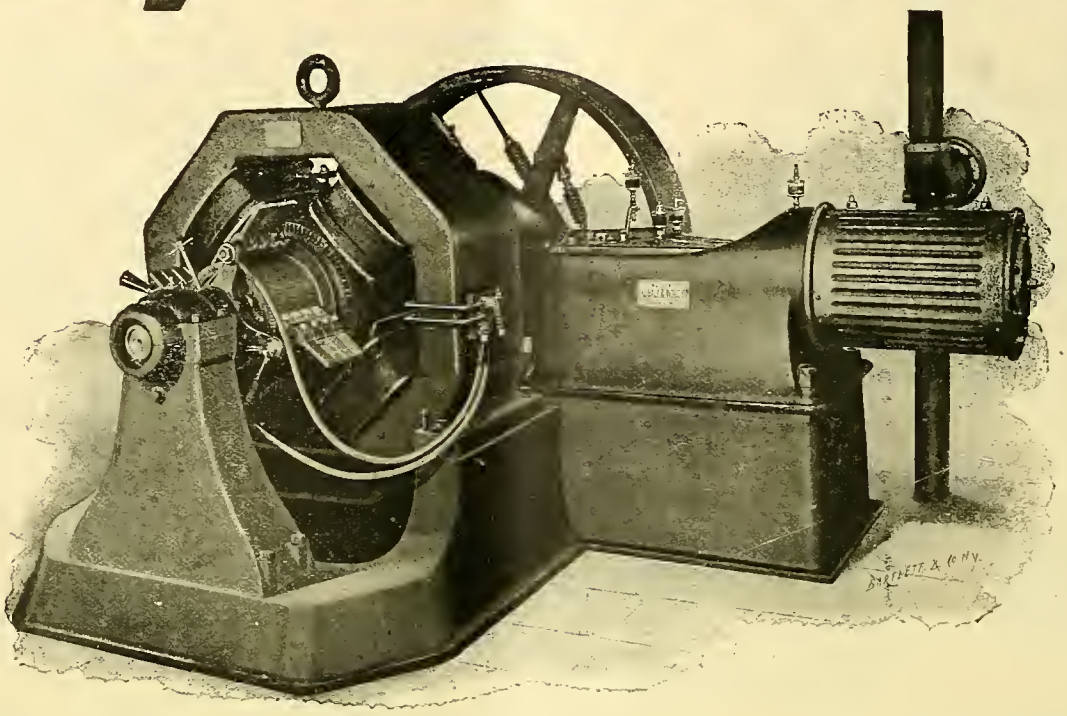
26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
PITTSBURG, PA.

New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

Eddy Generators



Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

EDDY MOTORS—SLOW, MEDIUM OR HIGH SPEED.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

All Our Apparatus Guaranteed as Represented.

The Eddy Electric Manufacturing Company,

WINDSOR, CONN.

New York, H. B. Coho & Co., Mail and Express Building.
Philadelphia, Walter C. McIntire & Co., 506 Commerce St.
Boston, G. M. Angier & Co., 64 Federal St.
San Francisco, Cal., California Electrical Works, 409 Market St.
Elmira, S. N. Blake.
St. Louis Western Electrical Supply Co.
Kansas City, W. T. Osborn.
Cincinnati, O., John A. Stewart.

Western Office: 204 Dearborn St., Chicago, Wallace & Hine, Western Agents.

"THE ELECTRA"

•TRADE MARK• HIGHEST GRADE NUERNBERG CARBONS. •TRADE MARK•

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

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L. W. DAVIS,
MURDOCK BUILDING,
CINCINNATI, OHIO.

HERCULES BATTERIES PERU ELECTRIC MFG. CO. PERU, IND.
LA CLEDE BATTERIES
PORCELAIN INSULATION Of all Kinds. We Solicit the making of SPECIAL DESIGNS OF PORCELAIN.

FLUOROSCOPES AND SCREENS

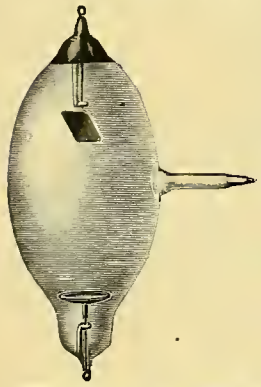
Of the recently discovered Fluorescent Crystals are being used by a large number of physicians, hospitals and experimenters, in place of tungstate of calcium and other salts, as they accomplish the result of showing each image undimmed by previous exposure or phosphorescence, make clear the most vague shadows which can not be traced when calcium of tungstate is used, and are absolutely instantaneous in effect.

A leading scientist says: "I find the Fluoroscopes and Screens of this Crystal an improvement over all others that I have used."

Made only by the

SPRING PARK LABORATORY,
JAMAICA PLAIN, MASS.
Also Complete X-Ray Apparatus, Scientific and Electrical Instruments.

THE ONLY GENUINE EDISON



X-RAY APPARATUS AND FOCUS TUBES

ARE MANUFACTURED BY

THE EDISON MANUFACTURING COMPANY.

Special Focus Tubes for Battery X-Ray Sets.
Special Focus Tubes for Direct Current X-Ray Sets.
Special Focus Tubes for Static Machine Work.
3, 4, 6, 8, 10 and 12 inch X-Ray Sets for Battery and 120-Volt Direct Current.

WRITE FOR NEW CATALOGUE.

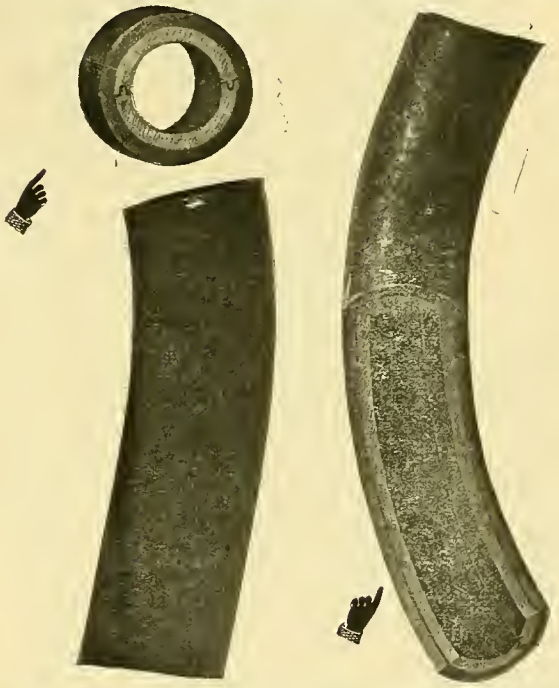
ALL OUR FOCUS TUBES ARE MANUFACTURED AT THE

EDISON LABORATORY.

EDISON MANUFACTURING CO.,
110 EAST 23d STREET, NEW YORK.

"ARMORITE"!

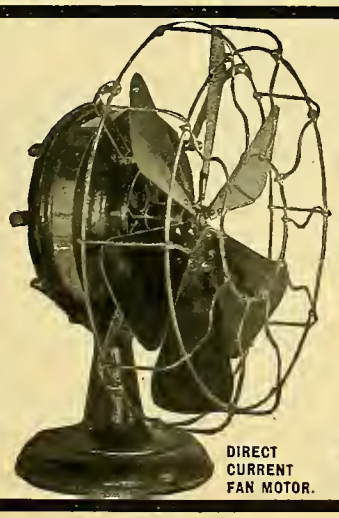
INTERIOR CONDUIT
(CUMMING'S PATENTS.)



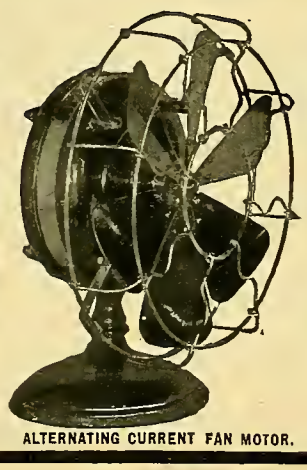
Note how the Wood-Lining does not crack.

ARMORITE INTERIOR CONDUIT CO., OFFICE AND WORKS, 476-480 FORT STREET, WEST, DETROIT, MICH.

ELECTRIC APPLIANCE CO., Chicago, General Western Agents.



DIRECT CURRENT FAN MOTOR.



ALTERNATING CURRENT FAN MOTOR.

GE '97 MODEL.

FAN MOTORS

FOR ALTERNATING CURRENT
—AND—
DIRECT CURRENT CIRCUITS.

GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

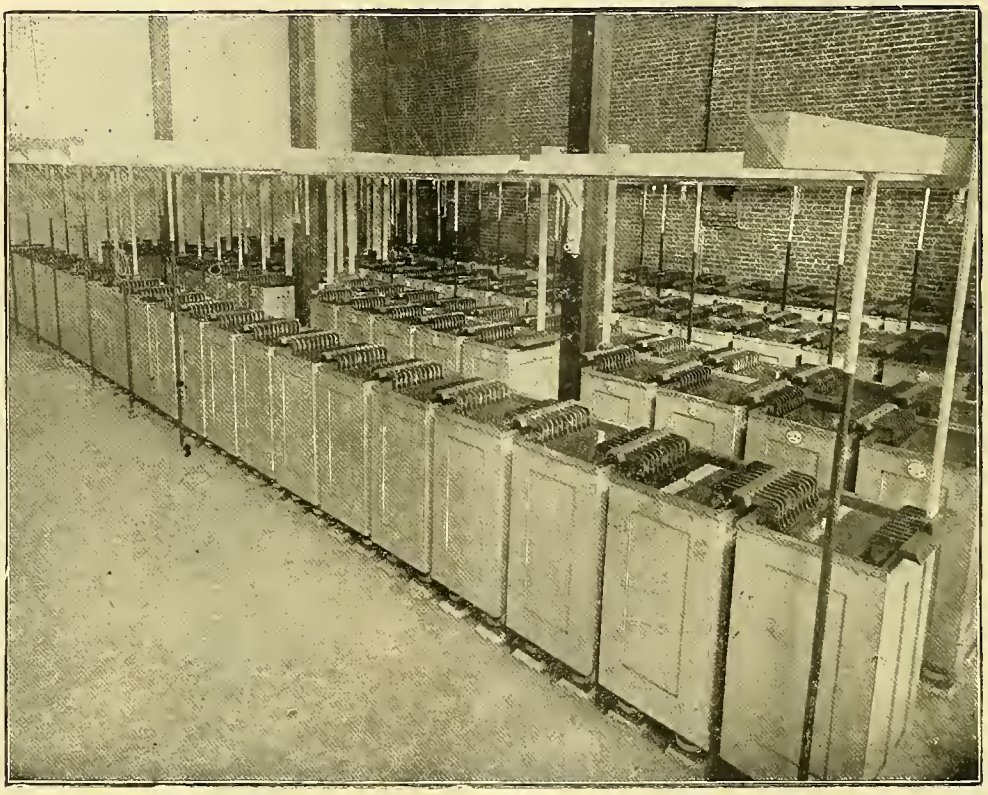
SALES OFFICES IN ALL LARGE CITIES IN THE UNITED STATES.

TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

BATTERY SUB-STATIONS INCREASE THE OUTPUT AT POINT OF CONSUMPTION.

Boston Edison Co.'s Third Battery Station.

(A FOURTH BATTERY, CAPACITY 8,000 AMPERE HOURS, NOW BEING INSTALLED.)



The First Independent Battery Station Built in America.
The Scotia Street Plant of the Edison Electric Illuminating Co. of Boston.

ELECTRIC STORAGE BATTERY CO.

Drexel Building, Philadelphia.

BRANCH OFFICES:

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222 Market St., SAN FRANCISCO, CAL. 92 State Street, BOSTON, MASS.

For Electric Launch Batteries and Apparatus, address The Electric Launch Company, Morris Heights, New York City.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

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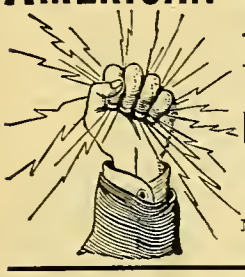
PROVIDENCE, R. I.



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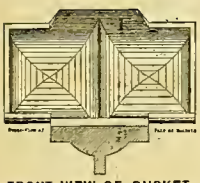

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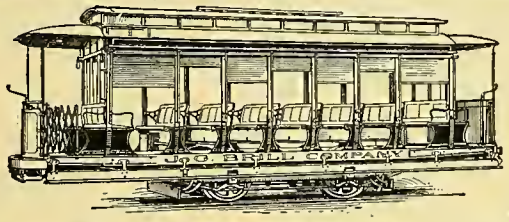

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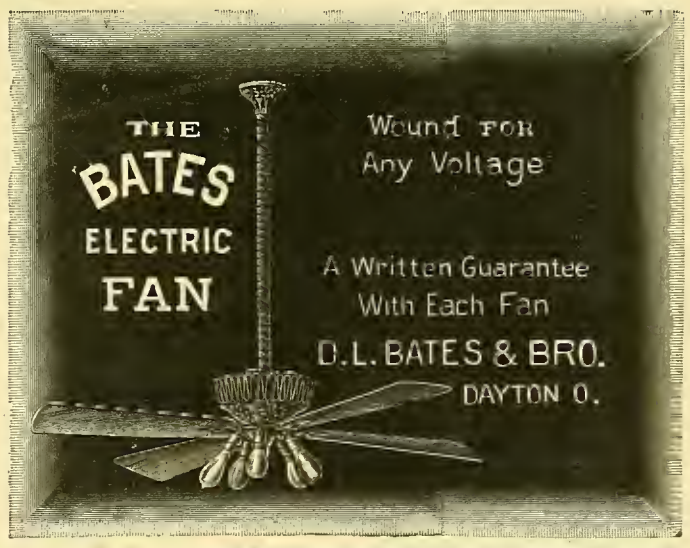

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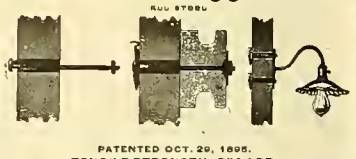

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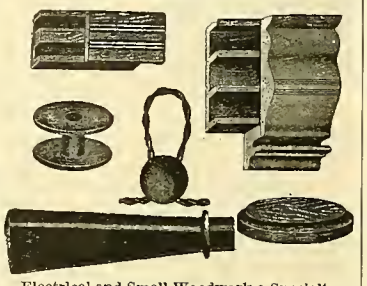

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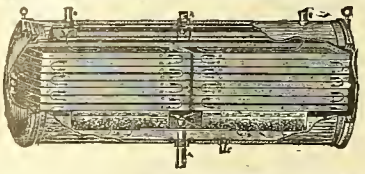

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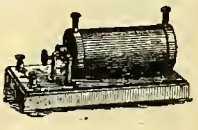

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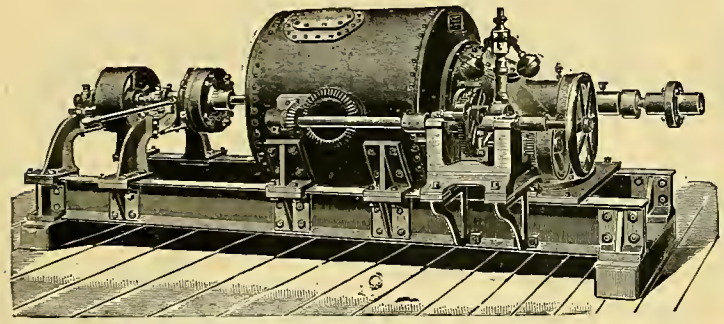

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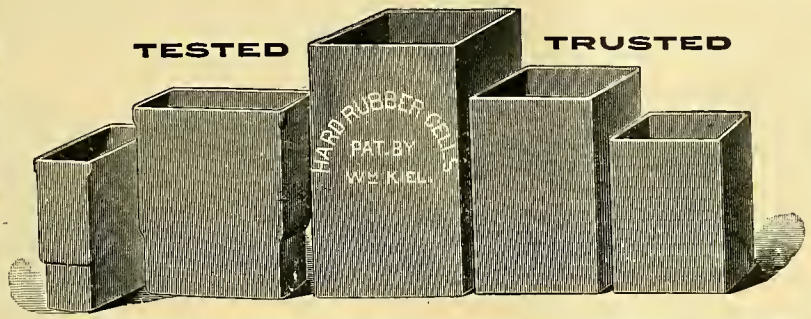

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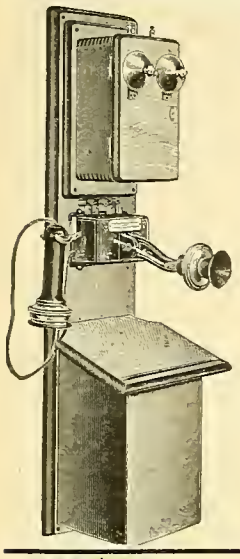

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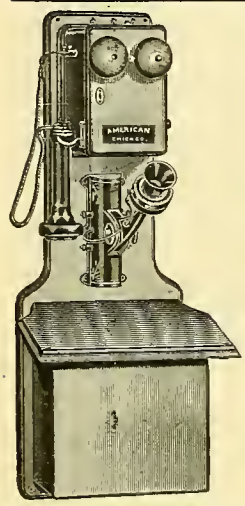

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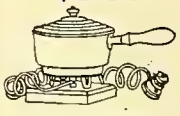

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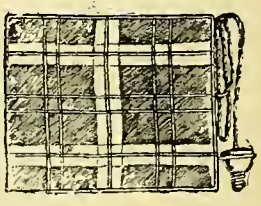

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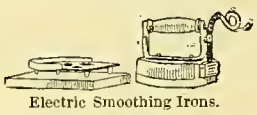

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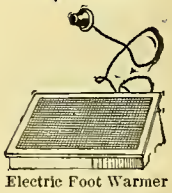

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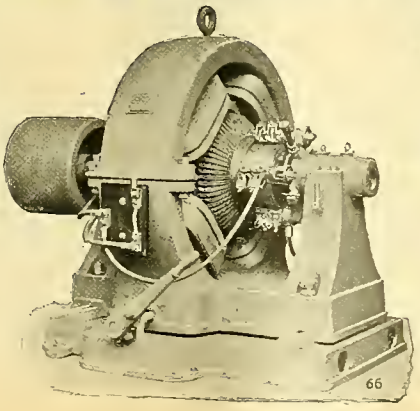

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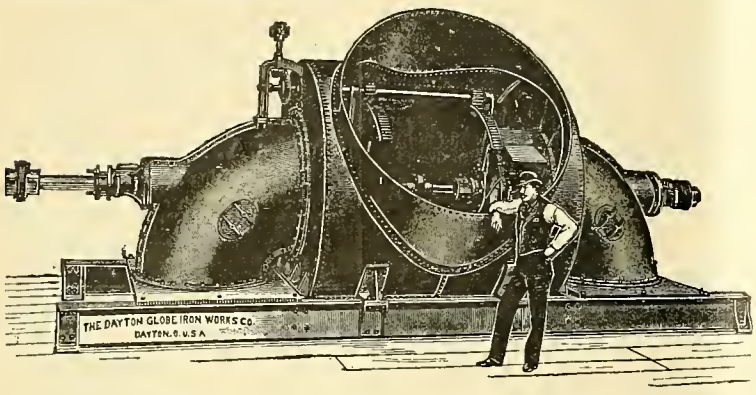

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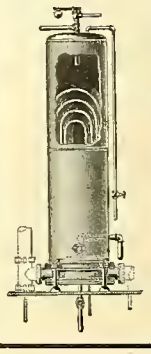

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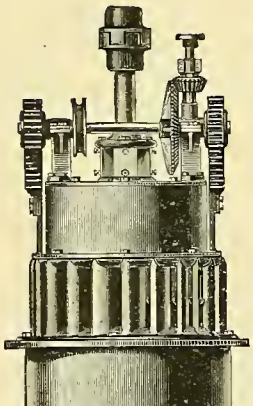

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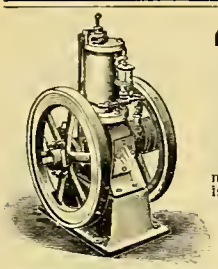

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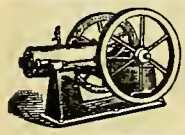

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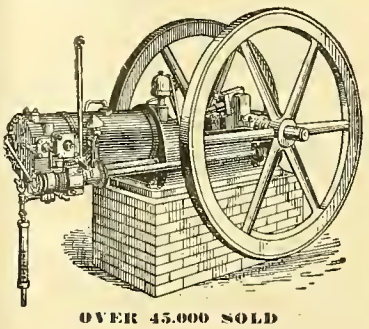

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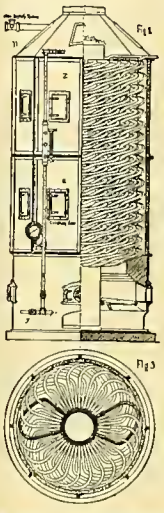

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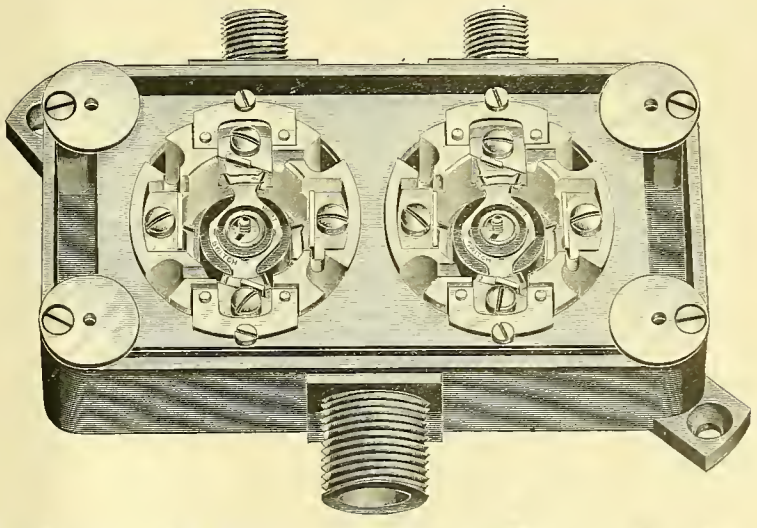

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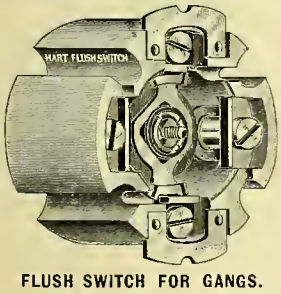

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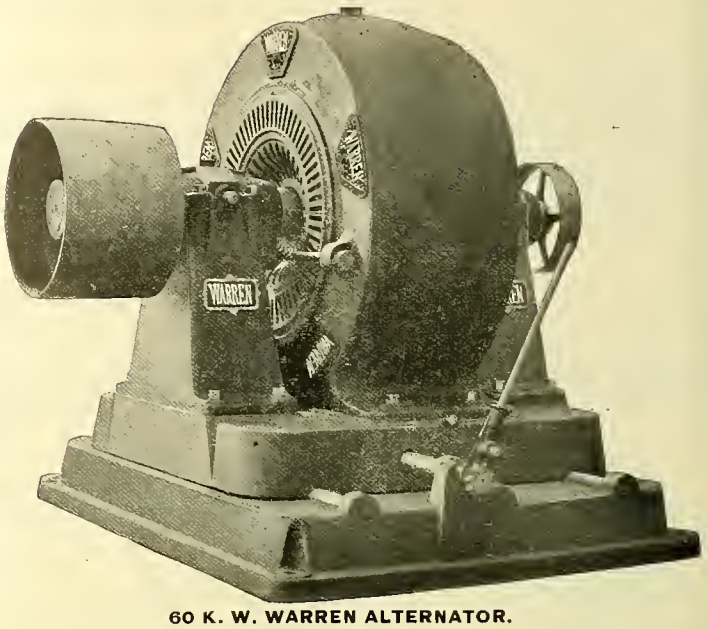

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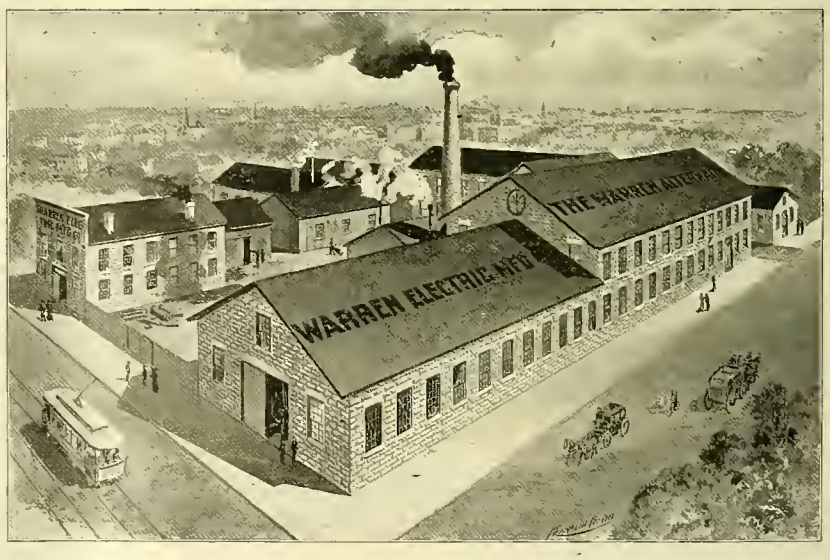

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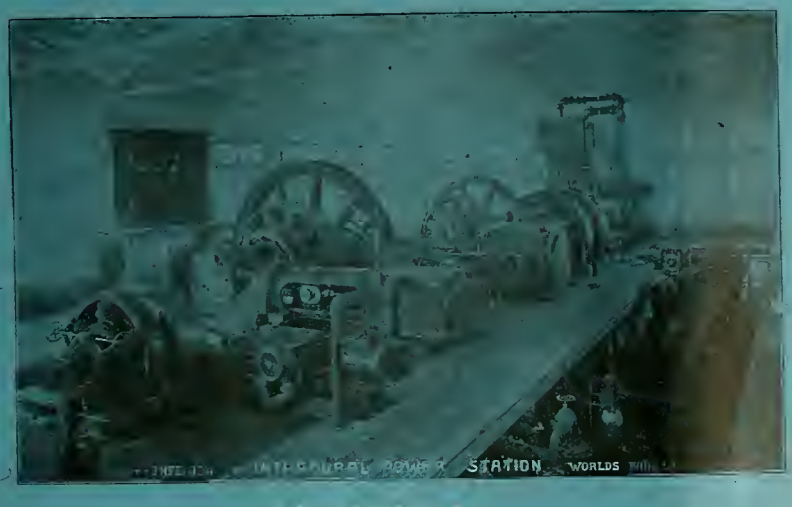

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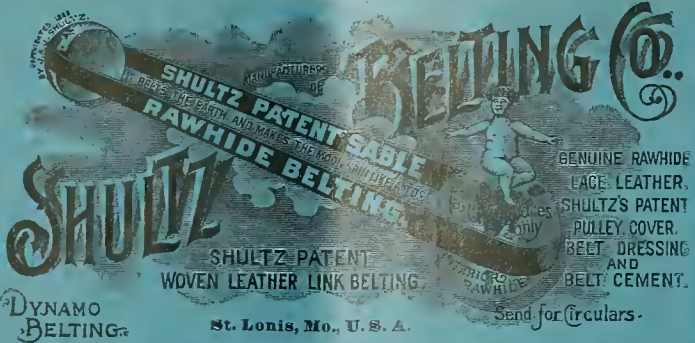

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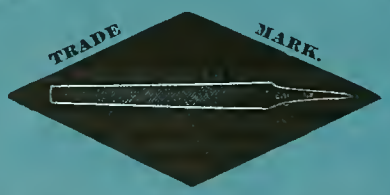

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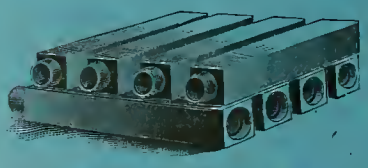

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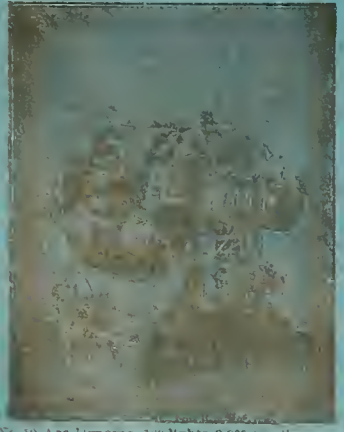
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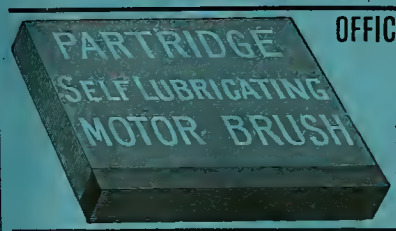

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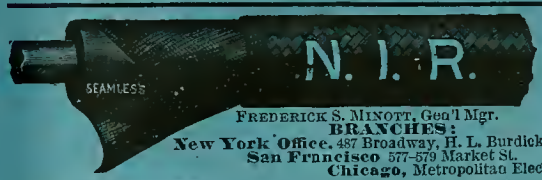

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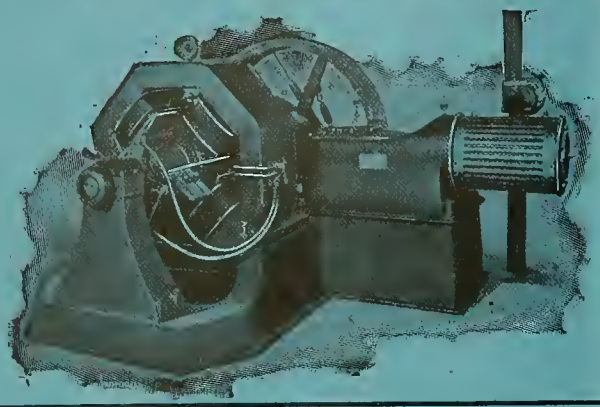

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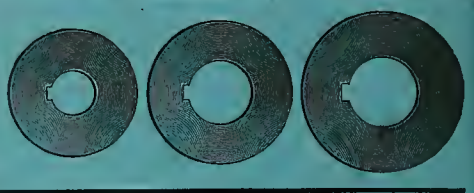

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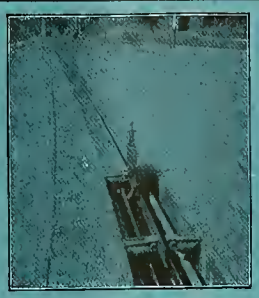

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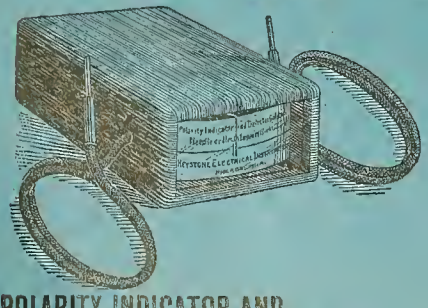

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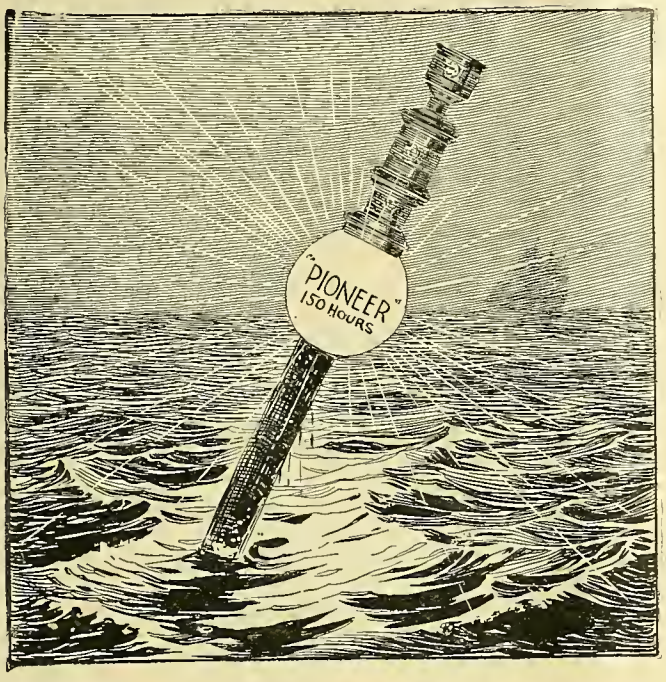

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Business Established 1865.
Incorporated 1892.

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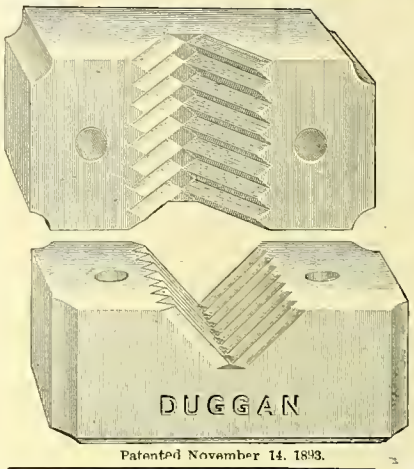
THE DUGGAN CLEAT

LEADS THEM ALL.



Patented November 14, 1893.

When ordering see that you get the DUGGAN.

Made in one wire No. 4, 5 and 6.
Two wire No. 2 and 3.
Three wire No. 1.

They are corrugated and V-shaped groove.
They grip like a vise.
No sagging wire when once stretched.
They are made of the finest glazed porcelain. Ten of them used to one of any other make.

No. 1, 3 and 4 holds wire 16 to 8.
No. 2 and 5 holds wire 6 to 00.
No. 6 hold wire 000 and larger.

Imperial Porcelain Works,

I. B. McKEAGUE, Western Manager,
324 Dearborn St., Chicago, Ill.
FACTORY, TRENTON, N. J.
Porcelain Specialties of all kinds.

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—TO—

The Bryant Socket.

It ALWAYS Bears the Name.

GOOD NAME,
GOOD REPUTATION,
GOOD GOODS.

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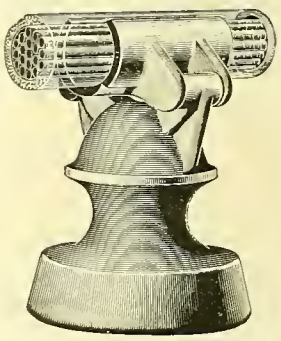
BRIDGEPORT, CONN. CHICAGO, ILL.

"H. W. J." Toggle Clamp

Feed Wire Insulator.



The weight of the wire in the hinged jaws automatically causes the wire to be clamped with a powerful toggle action. Wire may be instantly detached from insulator by lifting it out.

NO BINDING WIRES, NO SCREW CAP, NO DELAYS.

Economical, durable. No abrasion of insulation.

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Vulcabeston Parts for Controllers, Motors, Etc.

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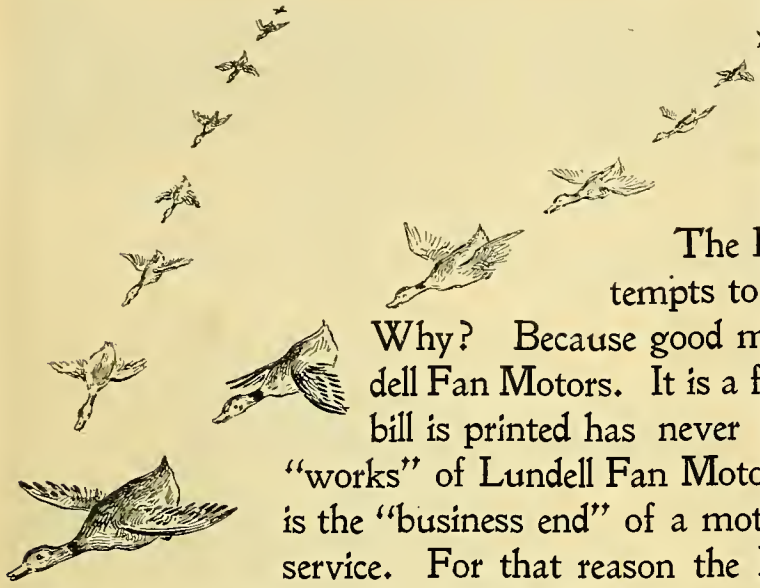

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Others strive to keep apace.

The Lundell Fan Motor is a Leader—notice the attempts to imitate it. Money is frequently counterfeited. Why? Because good money has value. Same reason applies to Lundell Fan Motors. It is a fact that the paper upon which a Government bill is printed has never been successfully counterfeited; likewise the "works" of Lundell Fan Motors have never been equaled. The armature is the "business end" of a motor and must be constructed to stand constant service. For that reason the Lundell Armatures are iron clad and wound with silk insulated wire, every inch of which is put on by hand and inspected. Others use cotton insulated wire put on by machinery. Why are Lundell Armatures wound with silk insulated wire? Because it has four times the insulating and heat resisting qualities possessed by cotton. Why do others use cotton insulated wire? Because it's cheap.

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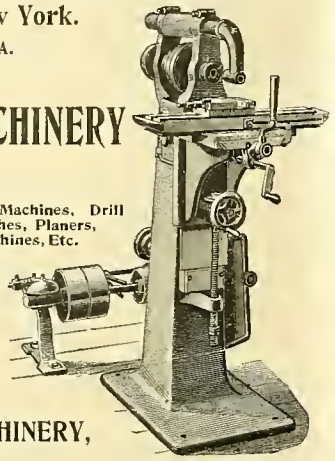

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Bogart, A. L.

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Elec. Eng. & Supply Co.
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Hodge, Walsh & Loring.
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Elec. Eng. & Supply Co.
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Gilmore El. & Mfg. Co.
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Okonite Co., The.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

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Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
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Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
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Phosphor Bronze Sm. Co. Ltd.

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Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
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Okonite Co., The.
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Dayton Globe Iron Works Co.
Leffel & Co., Jas.
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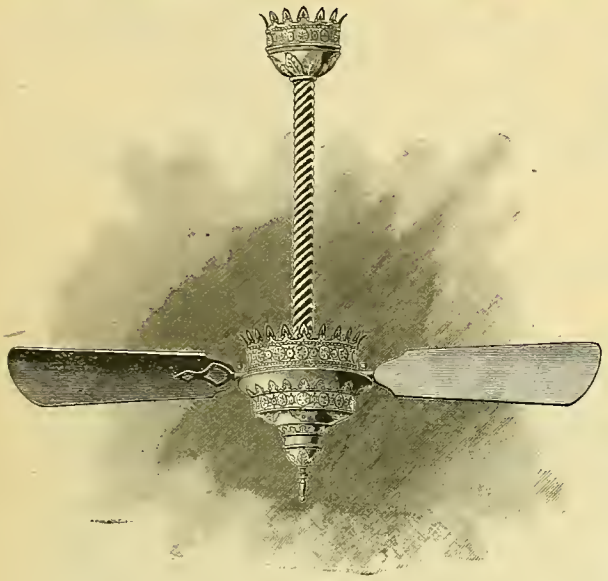

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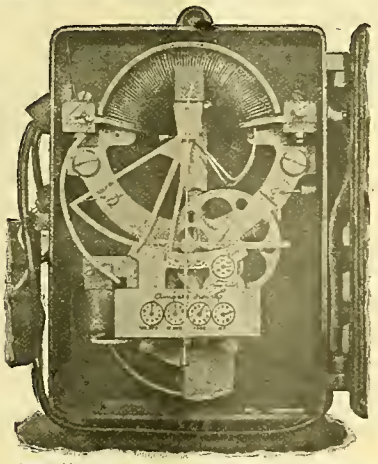

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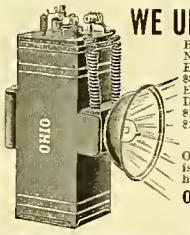
It gives a light that's white and bright,
And two cents is the cost per night.



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Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
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New York, 120 Broadway.
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For Canada address
Ahearn & Soper, Ottawa, Ont.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
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Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

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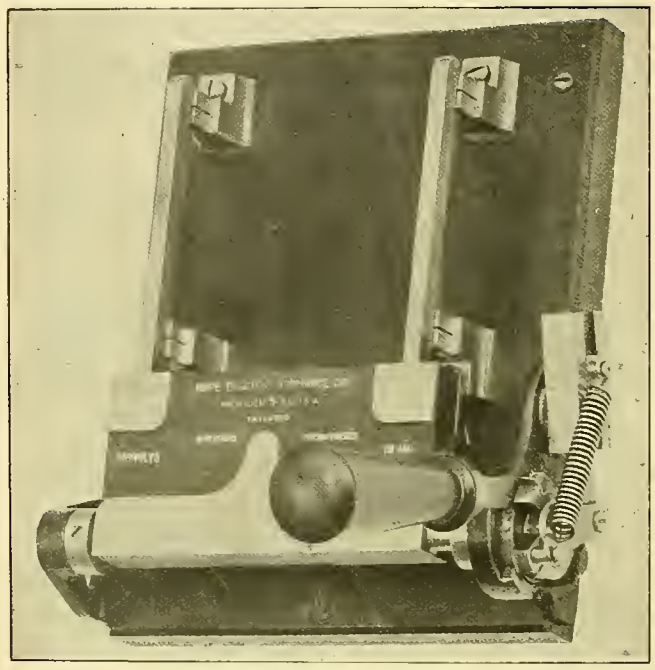
FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



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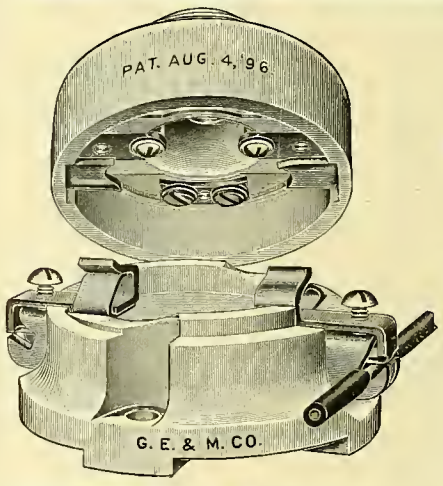
"Make and Break" Safety Knife Switches.

All Voltages. Approved by National Board of Fire Underwriters. Send for Catalogue.

Hope Electric Appliance Co.,

PROVIDENCE, R. I.



'96 LEADS.

WHY?

BECAUSE:

1st—Has perfect contact without marring softest wire.
2nd—Line wire is held by clamp instead of screw points.
3rd—It is easy to take apart; no screw driver, only a quarter turn.
4th—Can use long fuse.
5th—All that use them say so.

Write for Prices on Fuse Blocks, Etc.

GILMORE ELEC. & MFG. CO., North Easton, Mass.

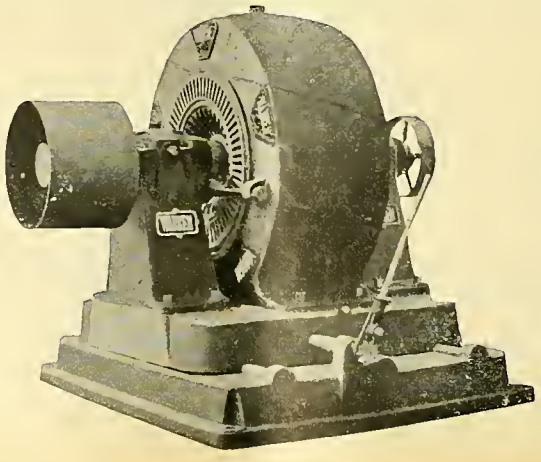
THE WARREN ALTERNATOR.

A DYNAMO without Collector Rings, or Commutator; without Brushes, without Moving Wires, without liability to "burn-out."

MASSIVE AND HEAVY, BUT EXTREMELY COMPACT.

Made for continuous runs without attention and proportioned to run up to an enormous overload without wasting energy in heating any part.

NOISELESS IN OPERATION.
A MONEY EARNER.



THE EMBODIMENT OF SIMPLICITY AND DURABILITY.

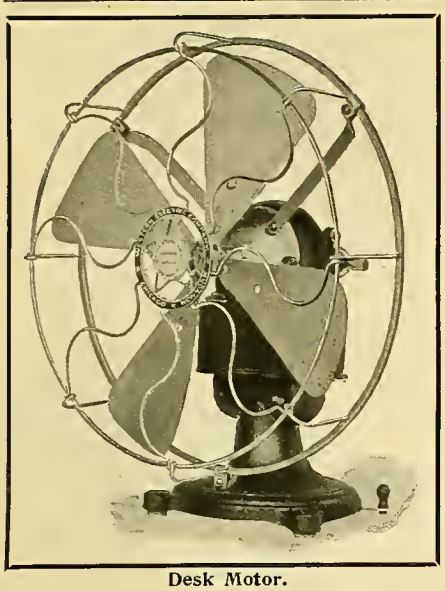
THE

MODERN DYNAMO

FOR CENTRAL STATION WORK.

Warren Electric Manufacturing Company,

SANDUSKY, OHIO.

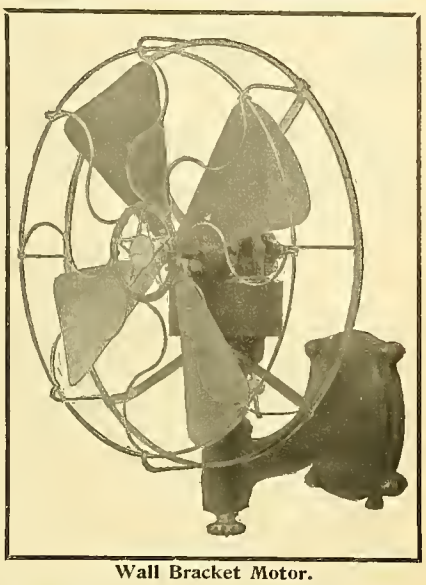


Desk Motor.

We Guarantee OUR FAN MOTORS

For the following reasons:

All of our 110 volt motors are tested on 220 volts.
Our 220 volt motors are tested on 500 volts.
Our 500 volt motors are tested on 1,000 volts, before they leave the factory.



Wall Bracket Motor.

The armatures are wound with the greatest care and the best silk-covered magnet wire is used. The commutators, the brushes and all wearing parts are carefully examined before a motor is packed for shipping.

Standard Motors for 1897.

WESTERN ELECTRIC COMPANY,

CHICAGO. Write for our illustrated book on fan motors. NEW YORK.

HERE IS THE "GLAD HAND"

OPAL, RUBY, FLESH TINT.

DAVIS INDICATING GLOBE,

COVERING INCANDESCENT LAMP.
(PATENTED)
MANUFACTURED ONLY BY

RUBY, Clear Letters.

THE PHOENIX GLASS CO.,

Manufacturers of Electric and Gas Globes, Shades, Etc.

RUBY, Clear Letters.

42 Murray Street, New York.

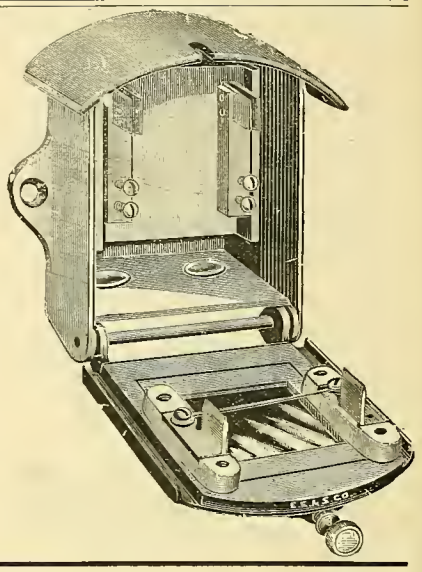
Length of Davis Globe, 11 Inches,
To Fit 3¼-inch Holder.

WRITE US FOR PRICES AND DISCOUNT.

RUBY, Clear Letters.

USEFUL! PRACTICAL!! PROFITABLE!!!

E. E. & S. JUNCTION BOXES.



The cut illustrates our improved Junction Box, designed to protect lamps from excess of current by means of safety fuses. Particularly adapted to be placed between feeder boxes and transformers. It is weather proof. . . . . .

ELECTRIC ENGINEERING & SUPPLY CO.,

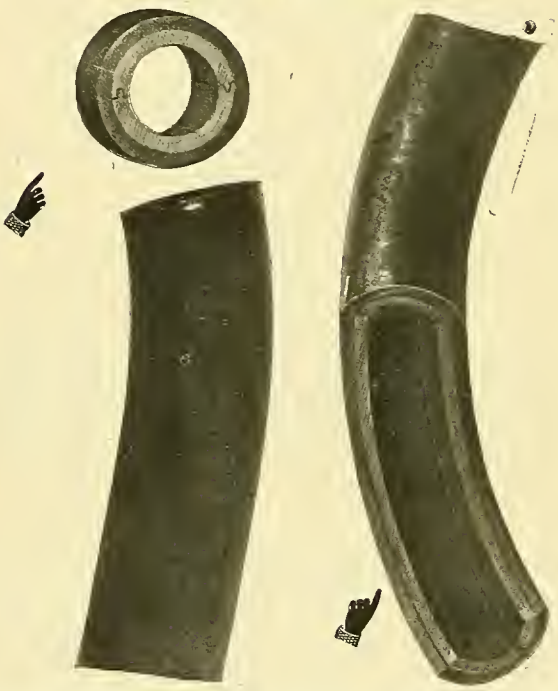
Manufacturers Electric Light Supplies,
SYRACUSE, N. Y.

New York Office: 27 Thames Street.

"ARMORITE"!

INTERIOR CONDUIT

(CUMMING'S PATENTS.)



Note how the Wood-Lining does not crack.

ARMORITE INTERIOR CONDUIT CO., OFFICE AND WORKS. 476-488 FORT STREET, WEST, DETROIT, MICH.

ELECTRIC APPLIANCE CO., Chicago, General Western Agents.

"AD." STUDIO
COMMERCIAL
ELECTRICAL
SUPPLY
CO.,
ST. LOUIS.

IT'S ONLY WILLIE—ADVERTISING ANOTHER OF OUR GOOD THINGS!

P. S.—Don't forget our big stock of Fans—all kinds and our prices!

TRANSFORMER ECONOMY. H

Result obtained with **TYPE H TRANSFORMERS** in place of **OLD TYPE TRANSFORMERS** having large iron core losses.

	March, 1895.	Jan., 1897.
Number of Transformers Connected	519	152
Capacity of Transformers in 16 C. P. Lamps	21485	13496
Capacity of 16 C. P. Lamps connected to Lines	16360	20189
Maximum Load, 16 C. P. Lamps	7000	10000
KW. Output per month at Switchboard	74804	47664
Receipt per KW. at Switchboard	.0438	.124
Total Receipt at Switchboard	$3276	$5910

H

Sales offices in all large cities of the United States.

For Canada address Canadian General Electric Company, Toronto, Can.

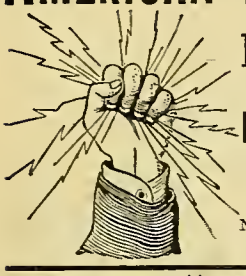
General Electric Company,

Main Office: Schenectady, N. Y.

EUGENE F. PHILLIPS, Prest. — F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



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ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

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CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.

All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

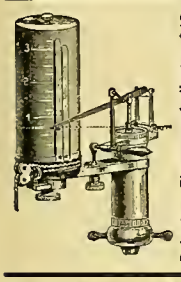
Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Manager.
HERBERT H. EUSTIS, Pres. and Electrician.

61-63 Hampshire Street, BOSTON, MASS.



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but can't spare the money." To such we say—let us know how much you can pay in cash—give us references, and we will take balance in installments.

HAVE YOU TRIED **EUREKA PACKING?** It lasts 3 to 4 times longer than any other. We manufacture Feed Water Heaters, Damper Regulators, Separators, Oil Extractors, Exhaust Heads, Filters, Etc.

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Successors to NINE & ROBERTSON CO.

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For Open and Closed Circuit Work.

The Perfect, Modern, Longest Lived and Most Economical Cell Ever Put on the Market.

In use by the leading cities, railroads, telephone and gas engine companies.

WE CLAIM:—Constant discharge of current without polarization; no local action; no noxious gases or fumes; no acids; least labor for operation; cleanest; not freezing at 28° below zero; economic value 50 per cent. greater than gravity cell, and 30 per cent. greater than best other cell in market. For No. 1 cell, 250 ampere hours; for No. 2 cell, 100 ampere hours; on open circuit, .9 to 1 volt; on closed circuit, .65 to $\frac{7}{10}$ volt. Send for circular and price list.

THE GORDON-BURNHAM BATTERY CO.,

82 to 86 West Broadway, New York City.
General Western Agent, S. F. B. MORSE, Marquette Bldg, Chicago, Ill.

J.G. Brill Company, Philadelphia,

MANUFACTURERS OF

ELECTRIC CARS AND TRUCKS,
SOLID FORGED FRAME TRUCKS,
TRUCKS FOR 4-WHEEL CARS.

PIVOTAL TRUCKS FOR STEAM AND ELECTRIC SERVICE.

The PERFECT TRUCK, our "No. 27," is safer, easier on rails, easier for passengers and imparts less motion to the car body than any truck ever made.

WE CAN SUBSTANTIATE OUR CLAIMS.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.,

WORCESTER, MASS.

BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Scranton.

Patented.

No. 11 DOUBLE GROOVE PONY INSULATOR

HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

HEMINGRAY GLASS CO., Covington, Ky.
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MAKE { IDEAL, SURE, CHEAP } LIGHT FOR { COUNTRY HOMES, SUMMER HOTELS, PUBLIC INSTITUTIONS.

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WEATHERPROOF WIRE.

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Electrical Engineering Co., Minneapolis.
St. Louis Electrical Supply Co., St. Louis.
The Bradford Belting Co., Cincinnati.

Phillips Insulated Wire Co.,

Office and Factory: PAWTUCKET, R. I.

WANTED.

For a new incandescent lamp factory, a practical lamp manufacturer; one familiar with all parts. A good position can be secured by one who is thoroughly competent and it would be useless for others to apply. Address "**Incandescent Lamp,**" care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

Situation by an electrician as superintendent of lighting plant, or foreman of construction; have had eight years' practical experience. Sober and industrious; am four years in my present position; references from my employer. Address "**INDUSTRIOUS,**" care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

A position as electrician or superintendent by a thoroughly competent man having ten years' practical experience in lighting and power systems. Can repair or install; will also invest some capital if satisfactory; references. Address "**Practical,**" care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

Position as electrical engineer or superintendent of electrical department. Fifteen years' practical and theoretical experience with leading manufacturing concerns; managed for last six years large power and light plant with six thousand h. p. generating capacity, motors from 1 to 80 h. p., 250 arc lamps, 3,000 incandescent lights, cross compound engines. Satisfaction and excellent references given. Address "**Electric Cranes,**" care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

Position as traveling salesman. Well acquainted with the electric trade in the middle and southern states. Can control large trade. Eight years' experience. Address "J. M. W.," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

For cash, two 50-light, 10 ampere arc machines, second hand.

MUNICIPAL ELECTRIC LIGHT PLANT,
PADUCAH, KY.

WANTED.

Situation by a first-class engineer and electrician of eight years' experience, competent of taking entire charge of an electric light plant. Familiar with compound, automatic and Corliss engines and direct, alternating and arc dynamos. Owns an indicator and kit of tools. First-class references. Address **W. C. Folsom,** BOX 147, Rockwell City, Ia.

WANTED.
ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

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100 number telephone switchboard; cause for selling same, owner wants board greater capacity. Address **J. H. McGILL,** 1130 Monadnock, Chicago.

FOR SALE.

One 65 k. w. Standard alternator; one a-18 General Electric alternator; one a-30 General Electric alternator; one 15 h. p. 500 volt Commercial motor; one 4 h. p. 500 volt Commercial motor; one 15 h. p. 500 volt Detroit motor; one 45 k. w. 500 volt Standard generator, and a full line of "Mayo" alternators. **V. J. MAYO,** 100 North Clinton St., Chicago.

FOR SALE CHEAP.

Six 25 amp. 110 volt dynamos, compound wound.
Six five horse power motors, any voltage.
Twelve ampere meters.
Twelve voltmeters. Write for prices.

HOLMES, PYOTT & CO.,
13 N. Jefferson St., Chicago.

U. S. Engineer Office, Montgomery, Ala., April 19th, 1897. Sealed proposals for furnishing and delivering at Pensacola, Fla., an electric plant and ammunition hoists, will be received here until 12 O'clock, M., May 29th, 1897, and then publicly opened. Information furnished on application. F. A. MAHAN, Major Engrs.

PROPOSALS FOR
Electric Lighting of Streets.

CLERK'S OFFICE OF THE TOWNSHIP of East Orange, N. J.

Sealed proposals are invited by the Township of East Orange, for the lighting of the streets of the township by electricity for a term of three years. All wires to be placed in underground conduits, lights to be 300 feet apart, to be of 1,200 candle power, and to be placed only on such streets as now have gas lamps. Proposals must be endorsed "Proposals for Electric Lighting" and addressed to Stephen M. Long, Township Clerk, and delivered to him on or before Monday evening, May 10, 1897, at eight o'clock. The Township Committee reserve the right to reject any or all bids received if deemed by them to be for the interest of the township so to do.

By order of the Township Committee.

STEPHEN M. LONG,
Township Clerk.

Dated April 28, 1897.

For Sale Cheap and in First-Class Condition.

One 500-volt flashing dynamo; one hydro-carbon electroplating machine; one metal case Wirt ammeter 0-15; one Packard vacuum pump, No. 2; one 66-gal. compressed air tank, pump and gage; nine mercury pumps complete; eight glass blowers' fires; two large wooden back rheostats; two Ward arc lamps; one Queen photometer (large size); one galvanometer, v. 44; one bridge; one 30-light combination gas machine; one Methvens screen; belting, lamp bulbs, and many items used in manufacture of incandescent lamps. **STANDARD ELECTRIC CO.,** Clinton, Wis.

FOR SALE.

One 30 h. p., 500 volt iron clad, second hand.
One 25 h. p., 500 volt iron clad, second hand.
One 250 ampere, 220 volt Manchester type, compound wound, new, complete.
One 150 ampere, 220 volt Manchester type, compound wound, new, complete.
One 7½ h. p., 220 volt iron clad motor, new.
One 2 h. p., 220 volt iron clad motor, new.
One ¾ h. p., 220 volt iron clad motor, new.
One 5 h. p., 220 volt Manchester type, second hand.

All the above machines have self-oiling bearings and guaranteed to be as represented. Write for prices.

Also the following:

One 15 light arc dynamo, new type Excelsior.
One 7 light arc dynamo, old type Excelsior.
Two 10 light arc dynamos, old type Bain.
Fifty double carbon Excelsior arc lamps.
Ten single carbon Rushmore arc lamps.
Nine single carbon Bain arc lamps.

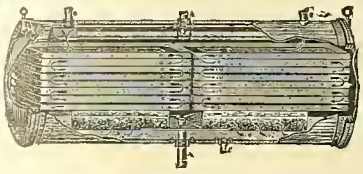
CHICAGO ARMATURE COMPANY,
(Incorporated),
14 and 16 North Canal Street, Chicago.

Scrap Copper Wire Wanted.

If you have any **Old Copper Wire** of any description to dispose of, it will pay you to communicate with us, as we are at all times in the market for any quantity of **Scrap Copper Wire,** at the highest market values. We pay cash and send prompt returns. We are also supplying the electrical trade with our high grade **Babbitt, Cotton Waste, Solder, Etc.** Please communicate with us.

SWARTS METAL REFINING CO.,
118 and 120 W. Lake Street, CHICAGO, ILL.

Stilwell's Patent LIVE STEAM-FEED Water Purifier.



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ENTIRELY PREVENTS SCALE IN STEAM BOILERS. Catalogue on Application.
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ARE THE BEST Send for Descriptive Circular.
Absolutely Non-Infringing. Protection Guaranteed.
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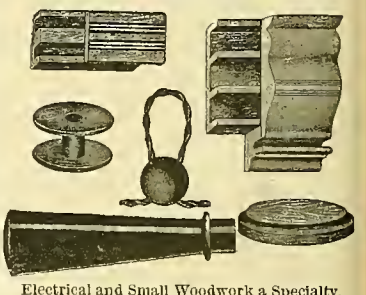
Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 970 LBS.



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Send for catalogue.
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INTERNATIONAL ELECTRIC CO.,

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New York.

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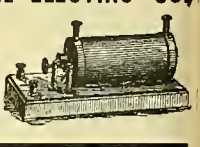

Telephone Coils, Experimental Work, Small Machinery, Binding Posts.

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CHICAGO ELECTRO. & STEREO. CO.,
196 and 198 S. Clark St., Chicago.

If Your Town Needs Light

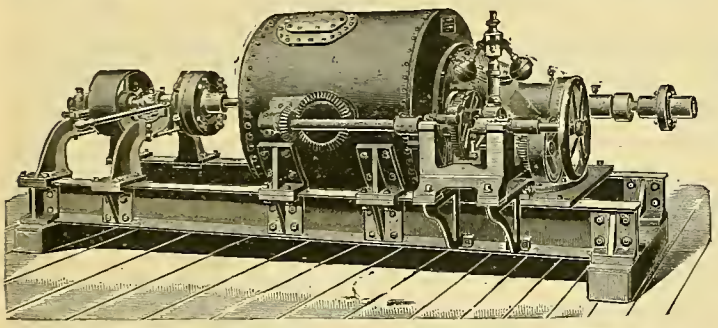
But has not the Price of a New Plant,

Write us for particulars of a complete plant now in operation which we will sell at a bargain.

Chicago Edison Company,

139 Adams St., Chicago, Ill.

Victor Turbine Water Wheel.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on accouot of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

THE STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, OHIO.

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The Coast Line to MACKINAC

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New Steel Passenger Steamers

The Greatest Perfection yet attained in Boat Construction—Luxurious Equipment, Artistic Furnishing, Decoration and Efficient Service, insuring the highest degree of

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LOW RATES to Picturesque Mackinac and Return, including Meals and Berths. From Cleveland, $18; from Toledo, $15; from Detroit, $13.50.

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Connecting at Cleveland with Earliest Trains for all points East, South and Southwest and at Detroit for all points North and Northwest.

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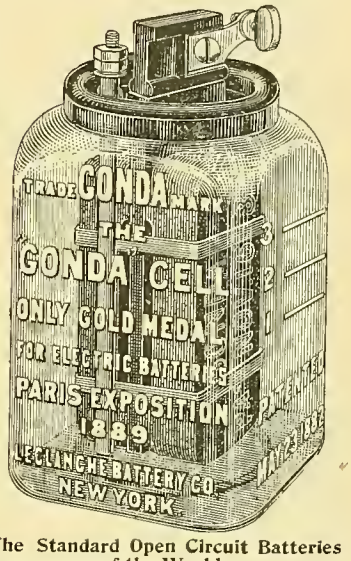

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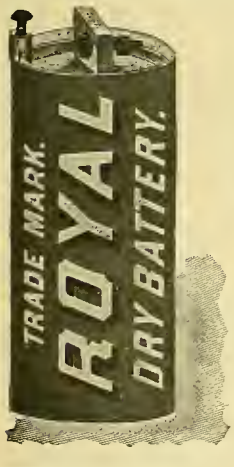

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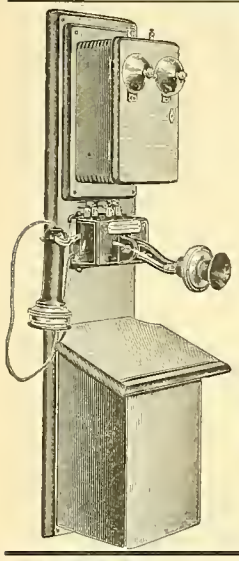

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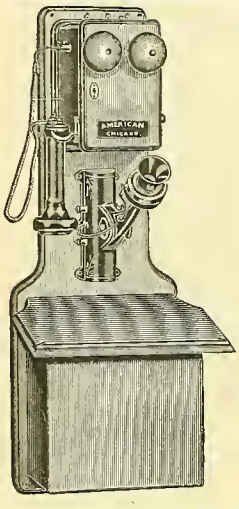

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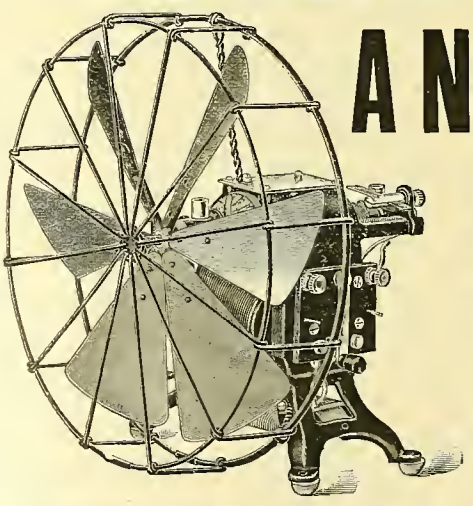

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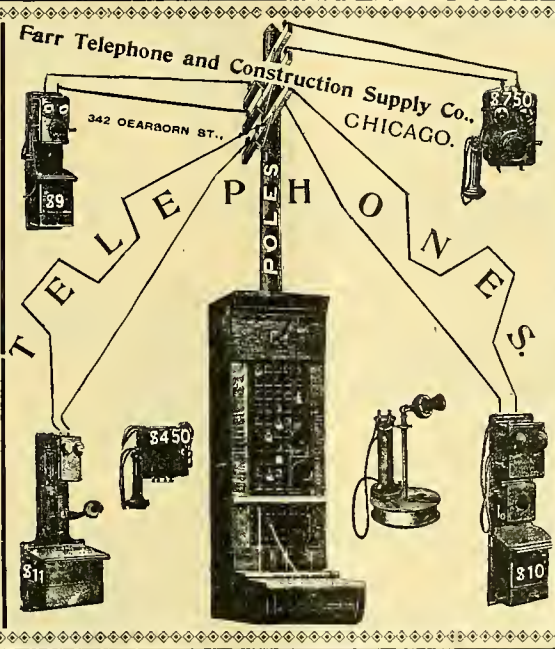

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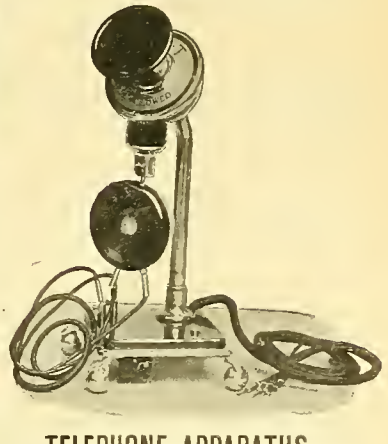

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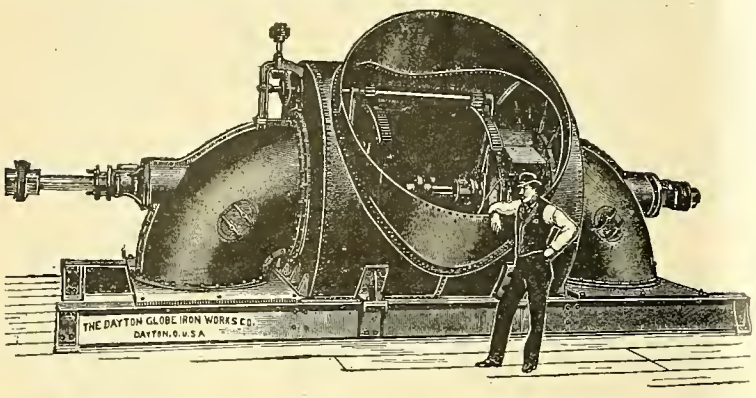

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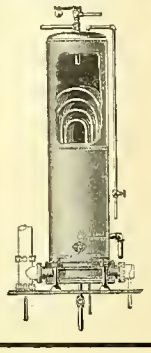

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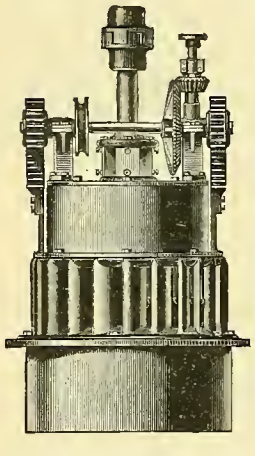

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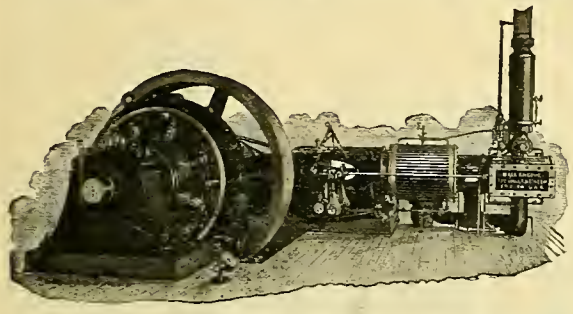

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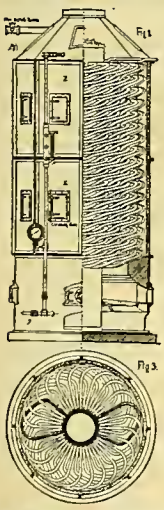

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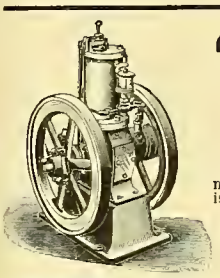

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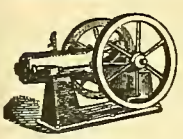

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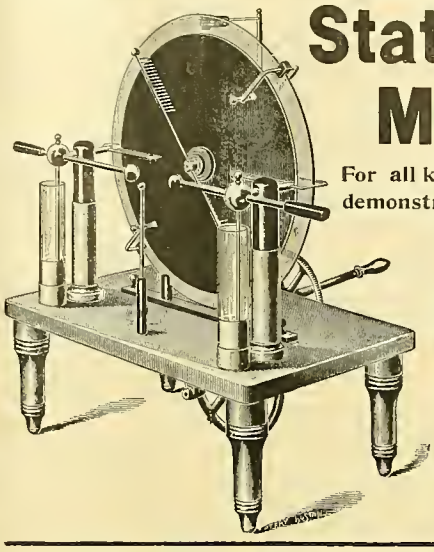

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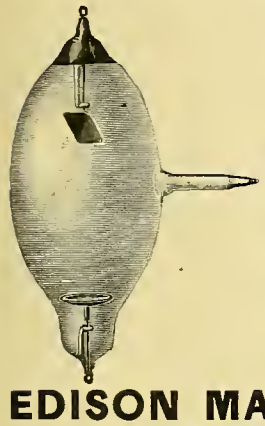

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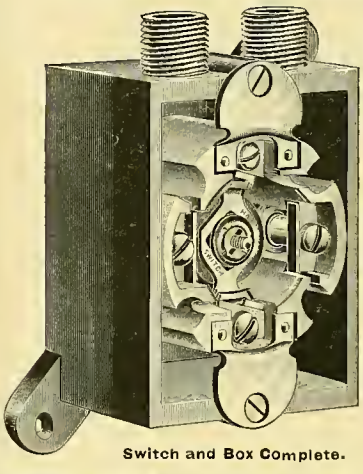

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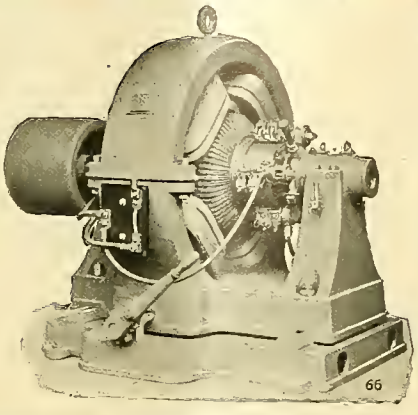

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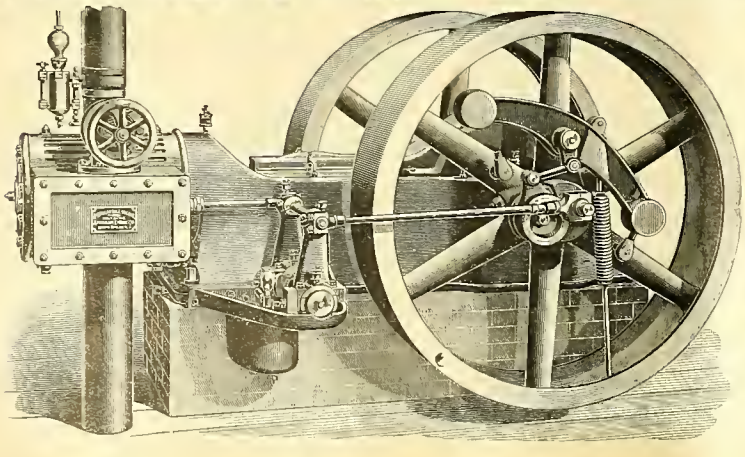

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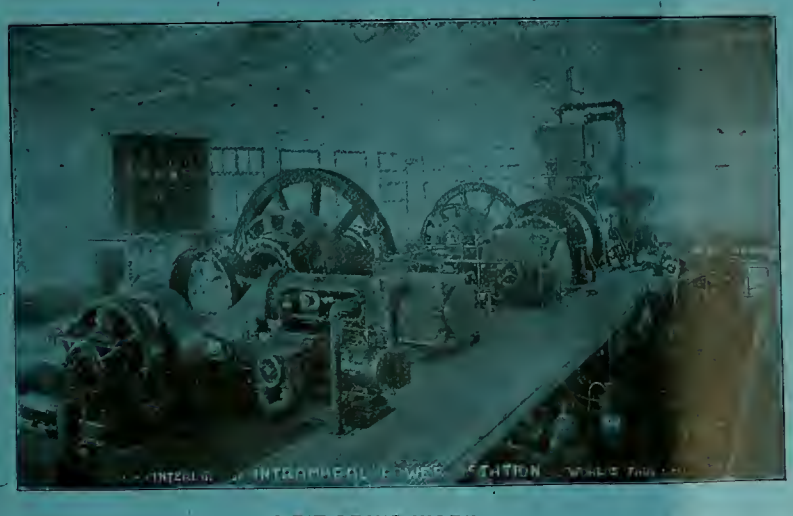

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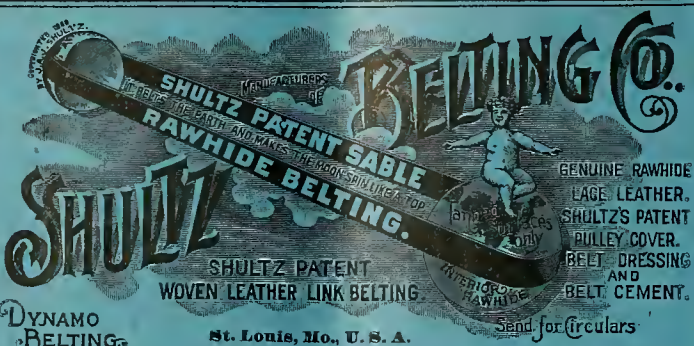

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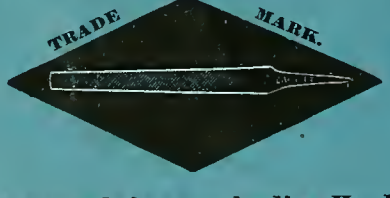

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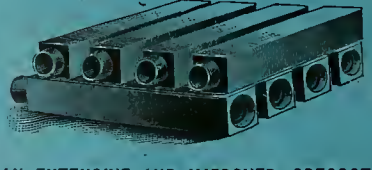

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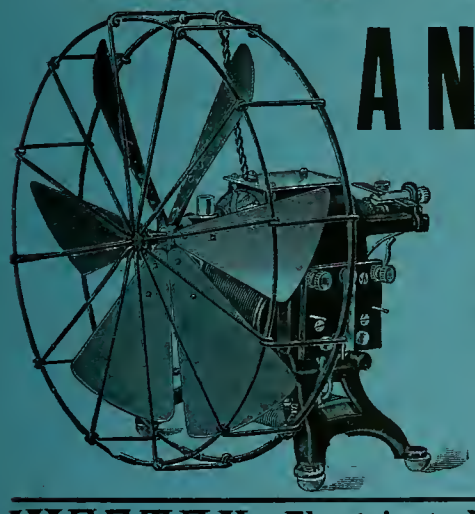

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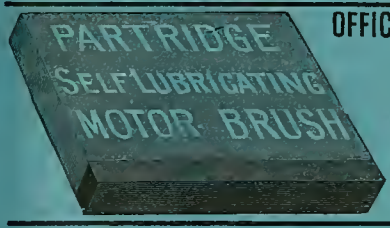

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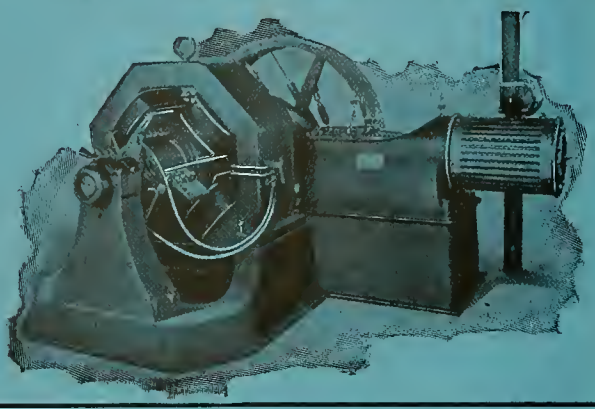

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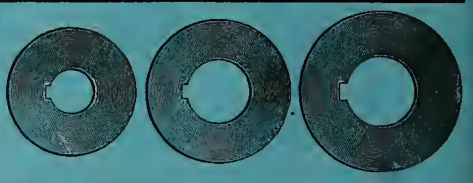

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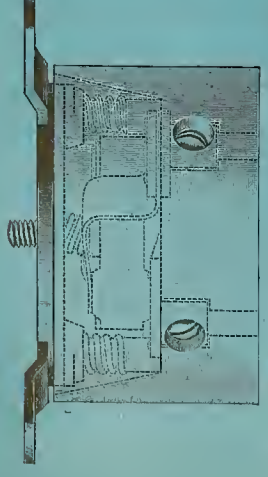

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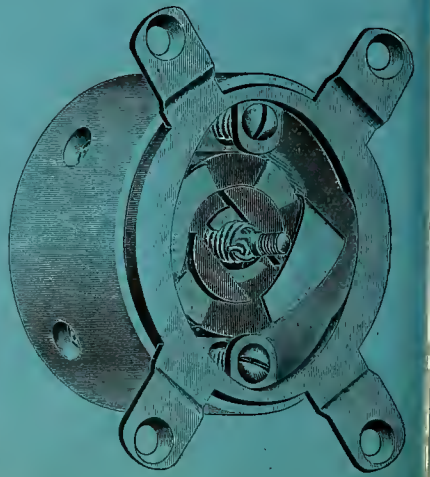

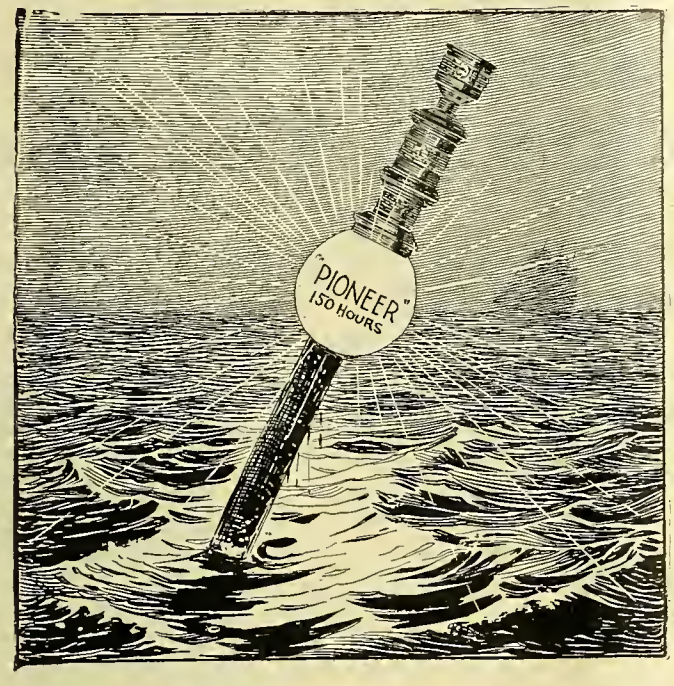

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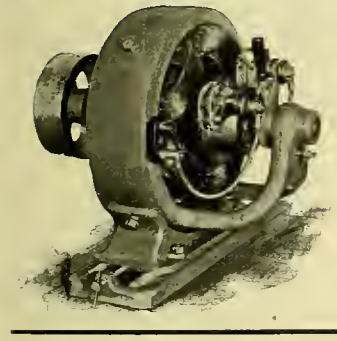

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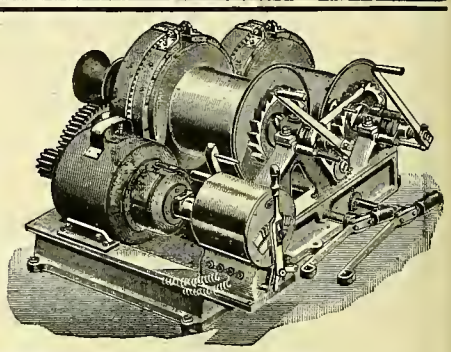

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BRANCH FACTORY: Hamilton, Canada

DALLETT Electric Motors and Generators,

MANUFACTURED BY

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York St. and Sedgley Ave.,
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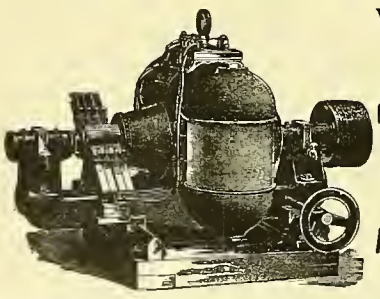

Portable Electric Drills, Starting Boxes and Controllers,

Automatic Switches. . . . . .
Flexible Insulated Couplings.

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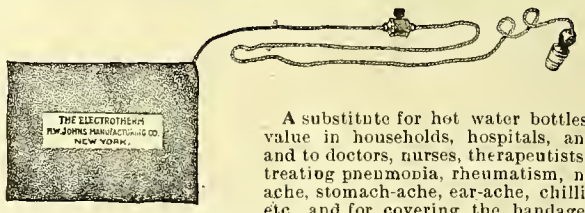

A substitute for hot water bottles, etc., of great value in households, hospitals, and sanitariums, and to doctors, nurses, therapeutists and others in treating pneumonia, rheumatism, neuralgia, toothache, stomach-ache, ear-ache, chilliness, cold feet, etc., and for covering the bandages over sprains, fractures, etc. The Electrotherm has been carefully perfected and is the only practical electric heating pad. Three degrees of temperature are furnished by the regulating switch. The operation of a thermostat at 210° F., which automatically regulates at that temperature, makes the Electrotherm perfectly safe in the hands of anyone. Inexpensive to operate. Thousands in use.

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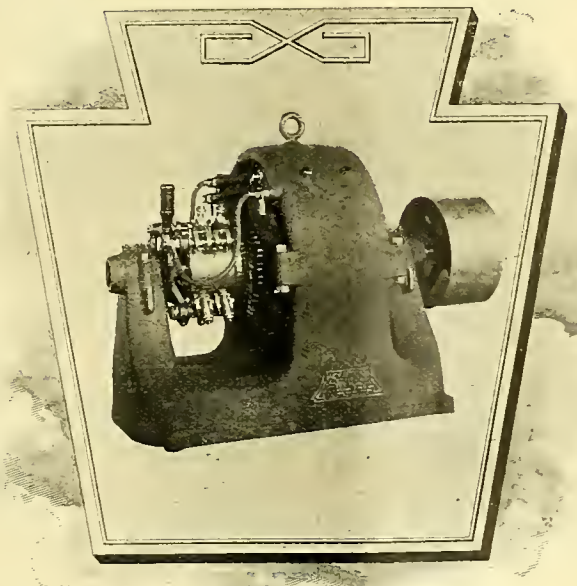

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Edison Mfg. Co.
Queen & Co.
Spring Park Laboratory.
Swett & Lewis.

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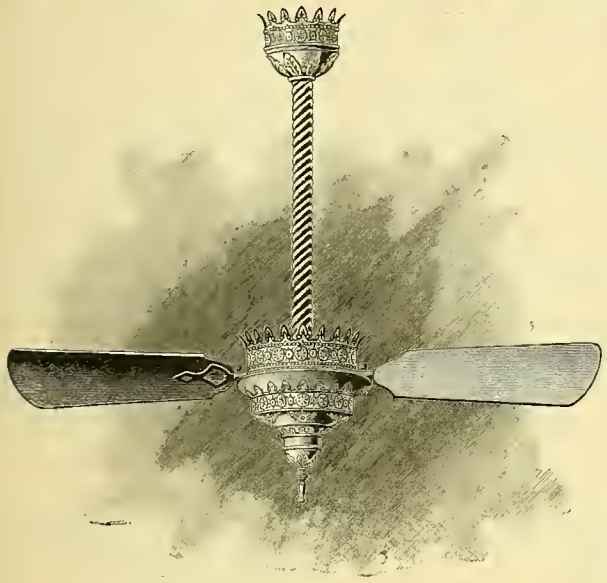
DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Onr Fans Furnished with Four Blades if so Ordered.

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DIEHL MANUFACTURING CO.,
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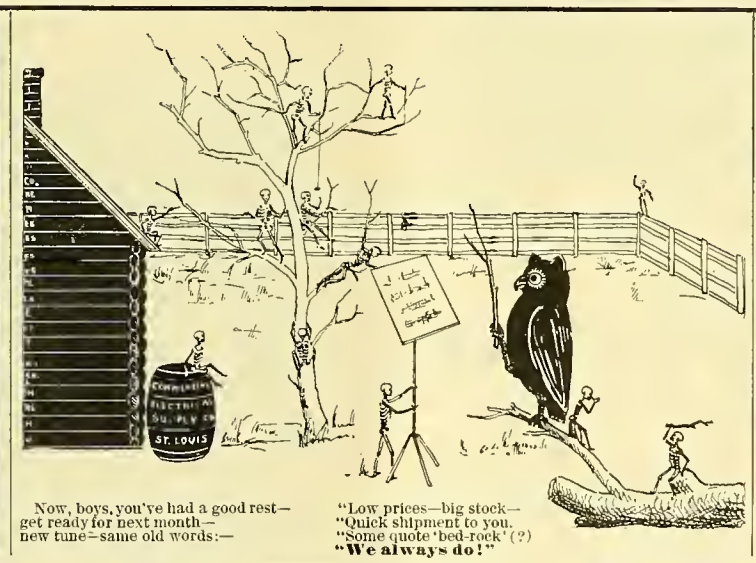
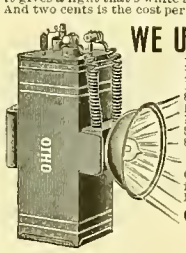


Now, boys, you've had a good rest—
get ready for next month—
new tune—same old words:—

"Low prices—big stock—
"Quick shipment to you.
"Some quote 'bed-rock' (?)
"We always do!"

It gives a light that's white and bright,
And two cents is the cost per night.



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Bicycle Electric Lights	$4.00
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$8 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.50

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Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.

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EASY RINGER.
PIVOTED ARMATURE,
DOUBLE ADJUSTMENT.
SEND FOR CATALOGUE.
HUEBEL & MANGER,
MANUFACTURERS.
290 Graham St., Brooklyn, N. Y.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

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Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

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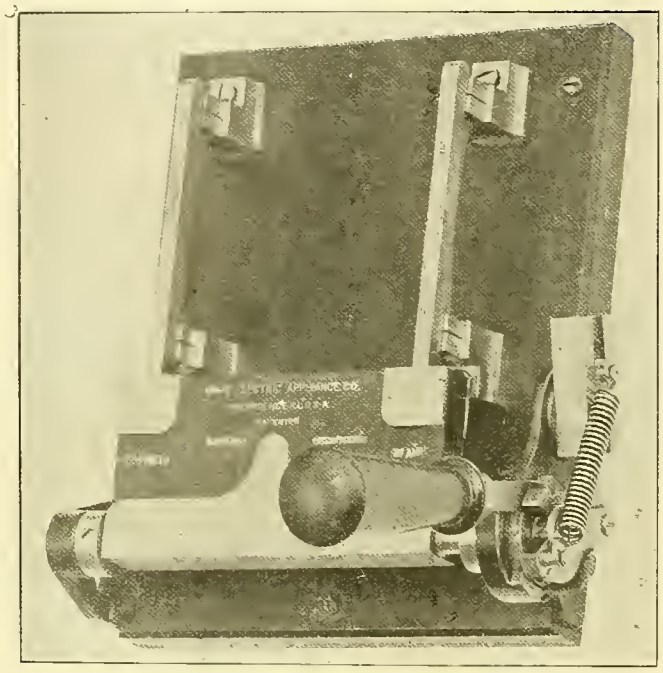
HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



INSTANTANEOUS "Make and Break" Safety Knife Switches.

All Voltages. Approved by National Board of Fire Underwriters. Send for Catalogue.

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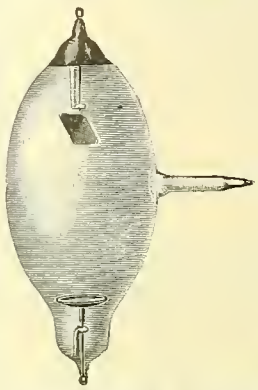

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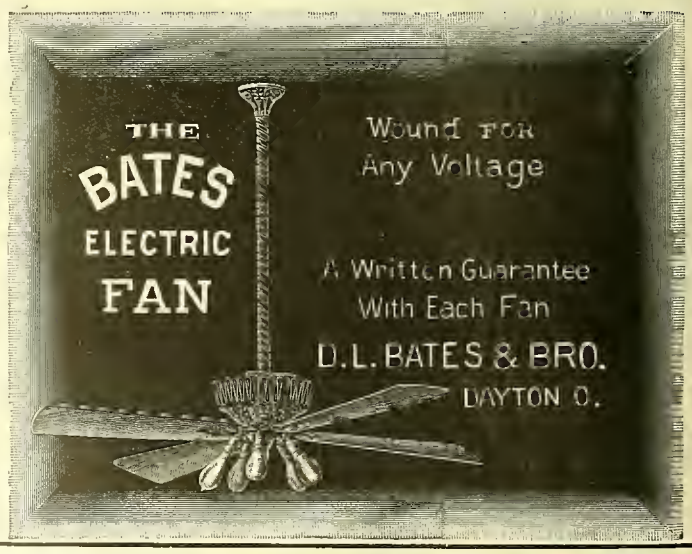

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A DYNAMO without Collector Rings, or Commutator; without Brushes, without Moving Wires, without liability to "burn-out."

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Made for continuous runs without attention and proportioned to run up to an enormous overload without wasting energy in heating any part.

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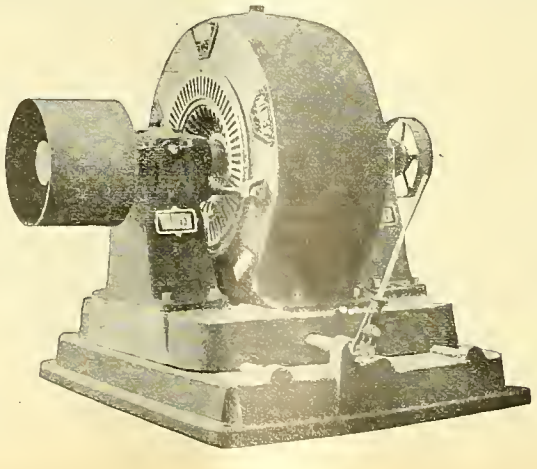

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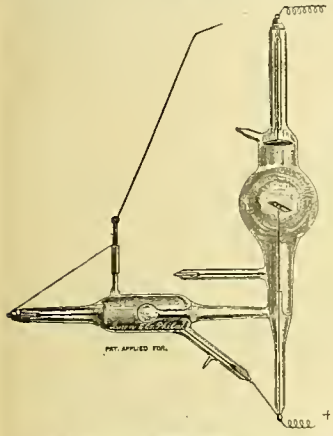

This Tube has the following points of advantage possessed by no other:

Adjustable Vacuum.
Automatic Control of Vacuum.
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Long Life.

Send for descriptive circulars:
194—The Queen Self-Regulating X-Ray Tube.
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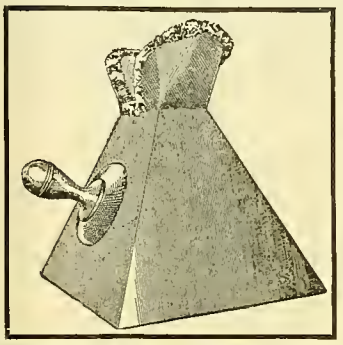

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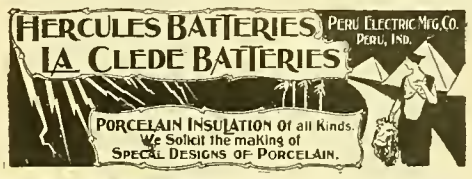

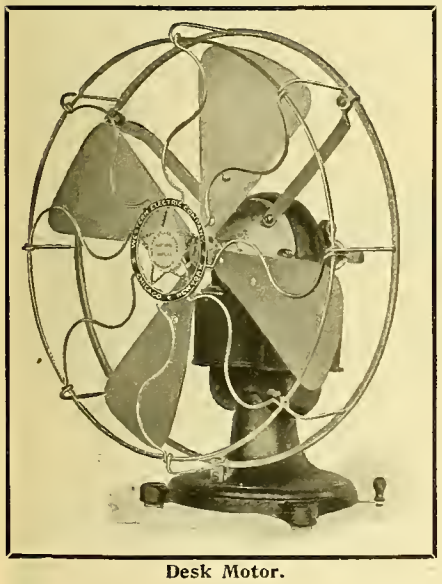

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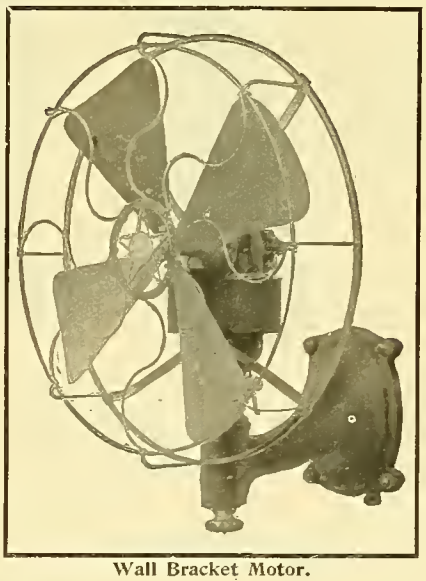
We Guarantee OUR FAN MOTORS

For the following reasons:

All of our 110 volt motors are tested on 220 volts.
Our 220 volt motors are tested on 500 volts.
Our 500 volt motors are tested on 1,000 volts, before they leave the factory.



Wall Bracket Motor.

The armatures are wound with the greatest care and the best silk-covered magnet wire is used. The commutators, the brushes and all wearing parts are carefully examined before a motor is packed for shipping.

Standard Motors for 1897.

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CHICAGO. Write for our illustrated book on fan motors. NEW YORK.

The Best of Incandescent Lamps for 12 cents each.

Send us your burned-out lamps and we will return them at the above price and GUARANTEE them to be equal to the best.

We have a good filament. We procure a vacuum superior to the mercury process.

We renew only those bulbs which have not lost their vacuum, and thus proven that they are without flaw.

We thoroughly clean the bulbs and tighten the loose collars.

Lamps to be renewed should be sent by FREIGHT, as we pay charges to our factory. Be sure your name accompanies shipments and advise us by letter of voltage, base, efficiency and candle power desired.

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GUARANTEED TO OPERATE PERFECTLY OR NO PAY. MADE FOR ALTERNATING OR DIRECT CURRENT. ANY VOLTAGE. CATALOGUE FREE.

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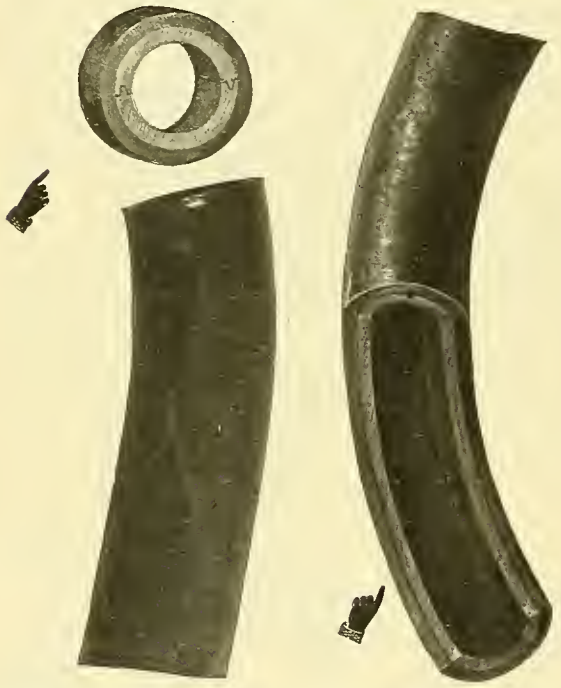
INTERIOR CONDUIT

(CUMMING'S PATENTS.)



Note how the Wood-Lining does not crack.

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GORDON PRIMARY CELL.

For Open and Closed Circuit Work.

The Perfect, Modern, Longest Lived and Most Economical Cell Ever Put on the Market.

In use by the leading cities, railroads, telephone and gas engine companies.

WE CLAIM:—Constant discharge of current without polarization; no local action; no noxious gases or fumes; no acids; least labor for operation; cleanest; not freezing at 28° below zero; economic value 50 per cent. greater than gravity cell, and 30 per cent. greater than best other cell in market. For No. 1 cell, 250 ampere hours; for No. 2 cell, 100 ampere hours; on open circuit, .9 to 1 volt; on closed circuit, .65 to $\frac{7}{10}$ volt. Send for circular and price list.

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TRANSFORMER ECONOMY. H

Result obtained with **TYPE H TRANSFORMERS** in place of **OLD TYPE TRANSFORMERS** having large iron core losses.

	March, 1895.	Jan., 1897.
Number of Transformers Connected	519	152
Capacity of Transformers in 16 C. P. Lamps	21485	13496
Capacity of 16 C. P. Lamps connected to Lines	16360	20189
Maximum Load, 16 C. P. Lamps	7000	10000
KW. Output per month at Switchboard	74804	47664
Receipt per KW. at Switchboard	.0438	.124
Total Receipt at Switchboard	$3276	$5910

H

Sales offices in all large cities of the United States.

For Canada address Canadian General Electric Company, Toronto, Can.

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Main Office: Schenectady, N. Y.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

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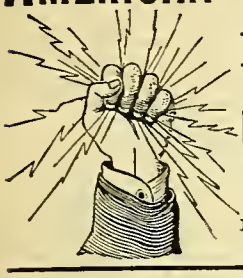

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WATER-WHEEL GOVERNOR
THAT GOVERNS.

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Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

LOMBARD WATER-WHEEL GOVERNOR CO.,
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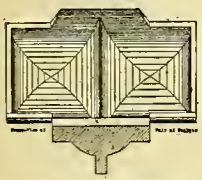

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FRONT VIEW OF BUCKET.

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No Wear on the Commutator.
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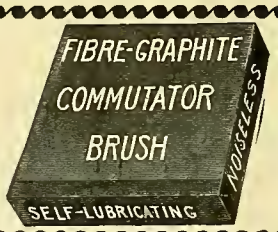

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TRUCKS FOR 4-WHEEL CARS.

PIVOTAL TRUCKS FOR STEAM AND ELECTRIC SERVICE.

The PERFECT TRUCK, our "No. 27," is safer, easier on rails, easier for passengers and imparts less motion to the car body than any truck ever made.

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"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

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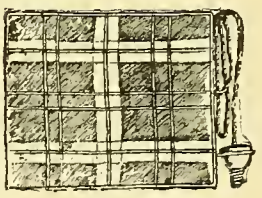

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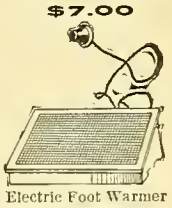

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Fifty double carbon Excelsior arc lamps.

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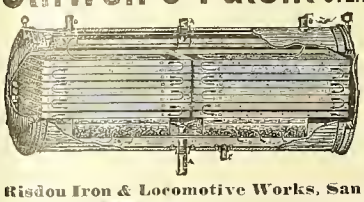

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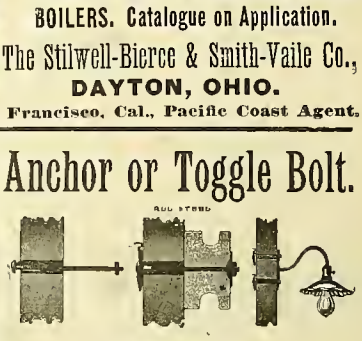

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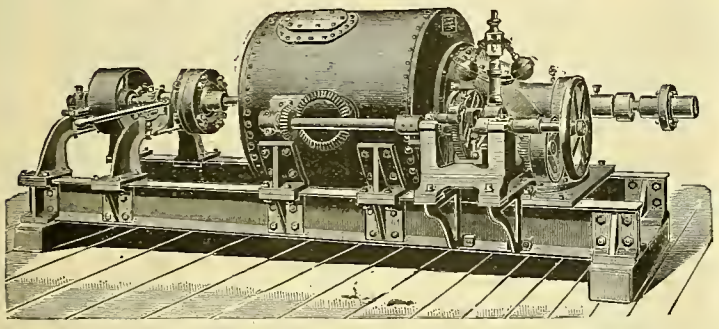

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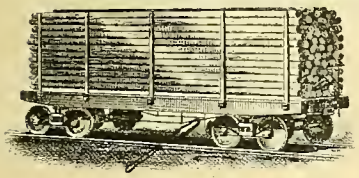

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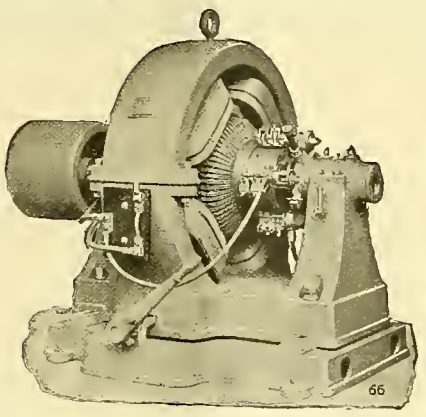

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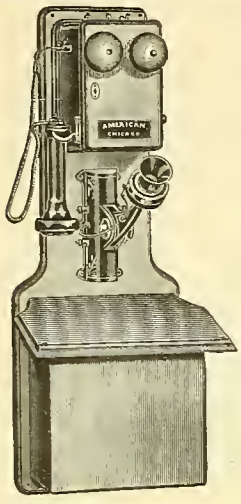

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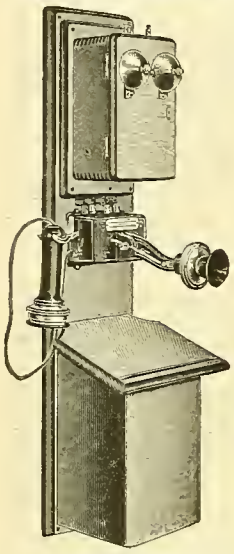

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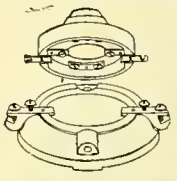

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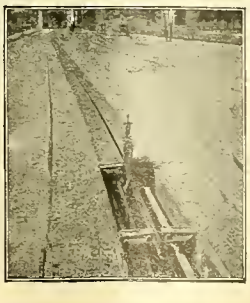

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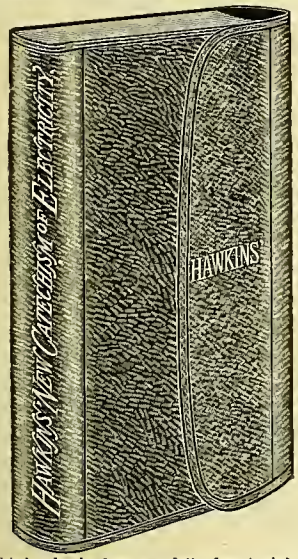

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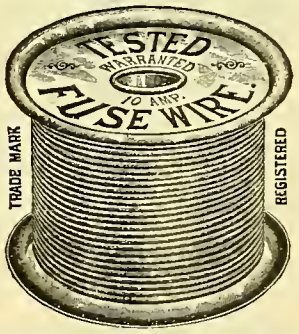

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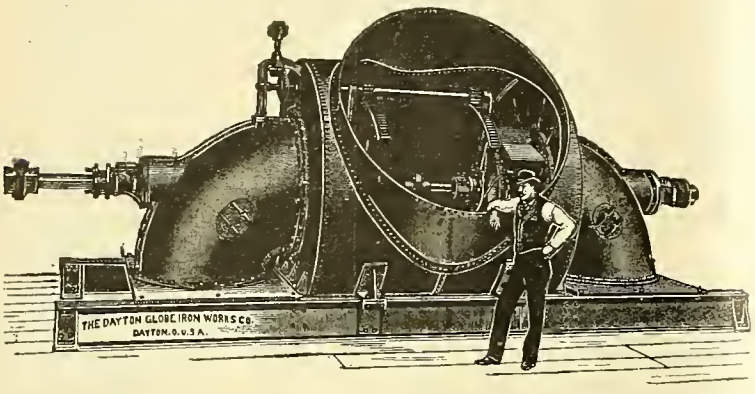

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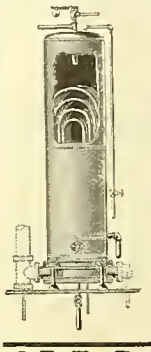

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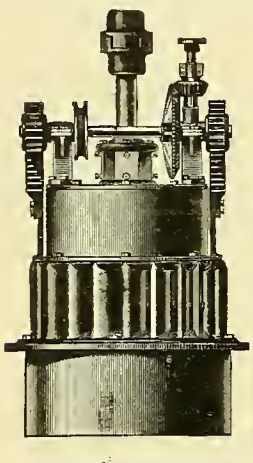

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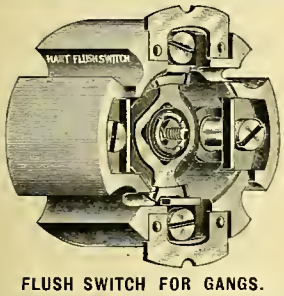

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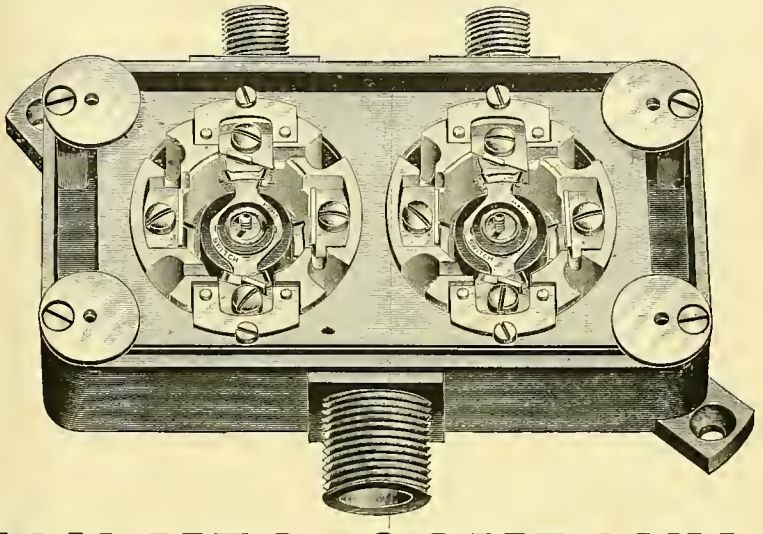

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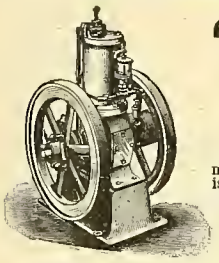

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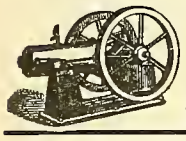

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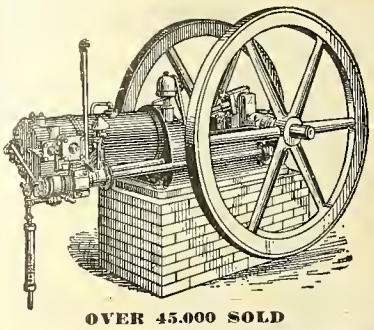

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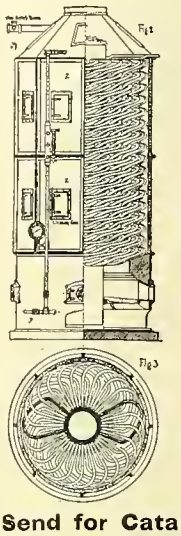

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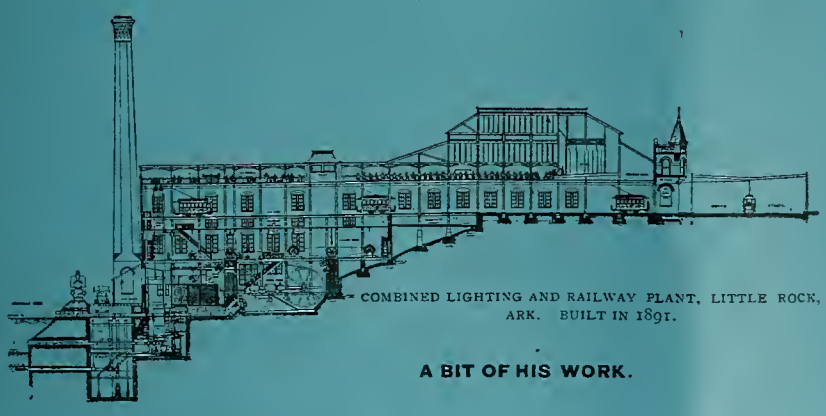

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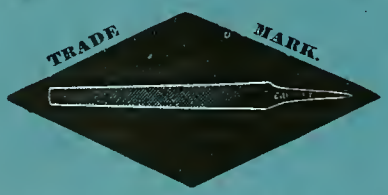

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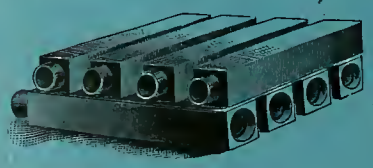

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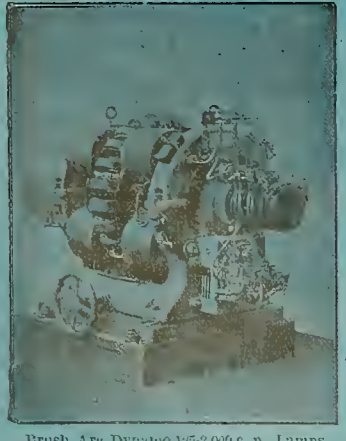
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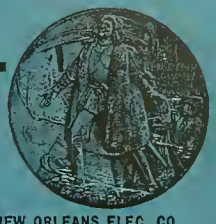

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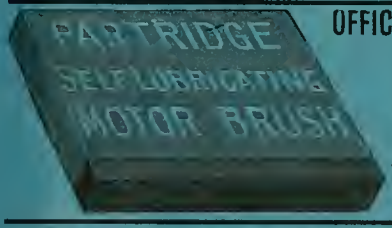

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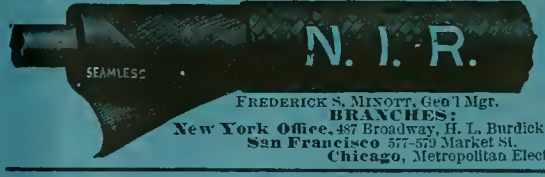
Smith & Wallace, Hamilton St., Boston, Mass.
Arthur S. Partridge, Bank of Commerce Bldg., St. Louis, Mo.
Joshua Hendy Machine Works, 42 Fremont St., San Francisco.
Central Electric Co., 173 Adams St., Chicago.
Harry M. Shaw, 120 Liberty St., New York.



NATIONAL INDIA RUBBER CO.'S Wires and Cables.

Factory and Offices: BRISTOL, - R. I.

FREDERICK S. MINOTT, Gen'l Mgr.

BRANCHES:

New York Office, 487 Broadway, H. L. Burdick, Mgr.

San Francisco 577-579 Market St.

Chicago, Metropolitan Electric Co., 186-188 Fifth Ave.

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New York, Havemeyer Building, Cortlandt St.
Pittsburg, Fidelity Building, Fourth Ave.
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Works, McKeesport, Pa.

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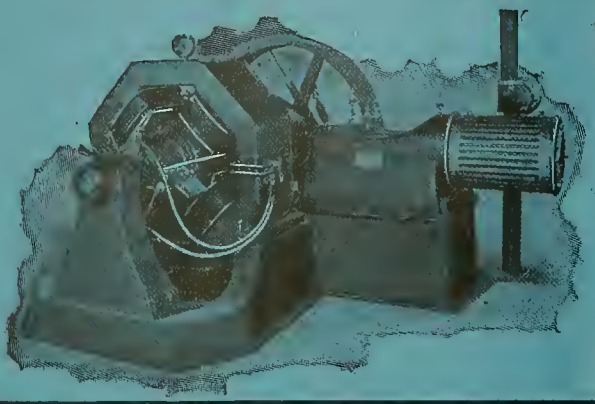

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We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

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ST. LOUIS, Western Electrical Supply Co.
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CINCINNATI, O., Nevada Bldg., John A. Stewart.
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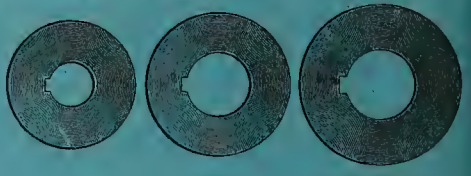

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IN THE MIDDLE STATES.

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Manufactured by

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ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

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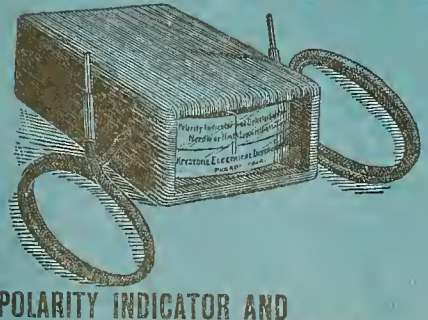

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This instrument will indicate polarity of light and power mains on two or three wire circuits, also polarity of dynamos and batteries. It will indicate on any direct current circuit from 1 volt to 700 volts.

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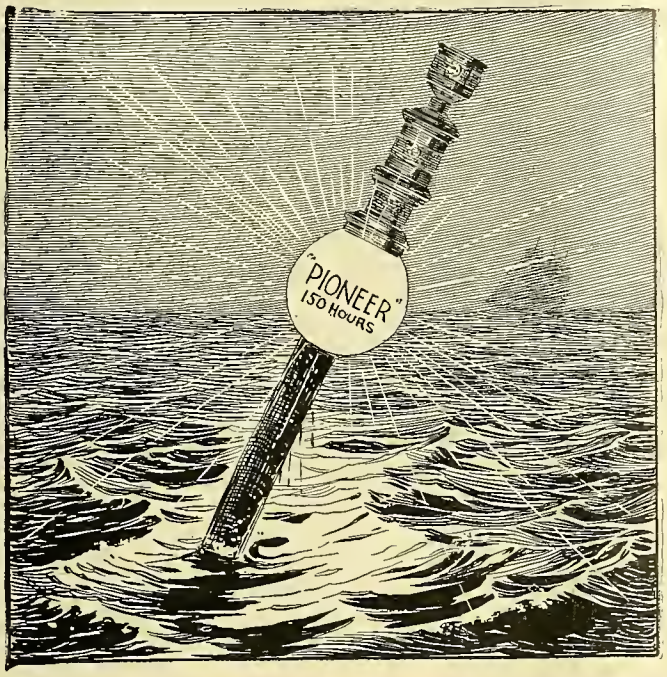

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150 HOURS.

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REPAIR SHOPS

In the West. ELECTRICAL REPAIRS AND MACHINE WORK OF EVERY DESCRIPTION. In having your repair work done by a company operating hundreds of dynamos and motors you are sure of good work and get the benefit of our experience. NO SCRAP WIRE USED.

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THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

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Business Established 1865.
Incorporated 1892.

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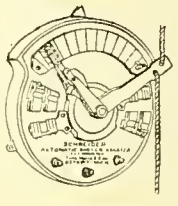

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PRICES GREATLY REDUCED.

WRITE YOUR JOBBER FOR REVISED FIGURES.

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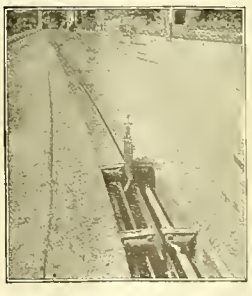
Simple in Construction.

Successfully Stood the Severe Tests of Last Winter's Snowstorms.



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Circuits.

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IT NEVER DISAPPOINTS

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Fan
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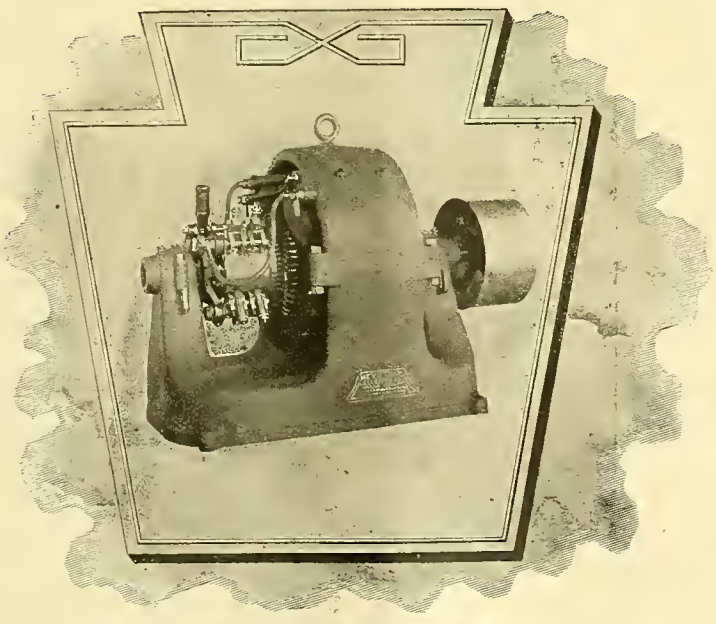

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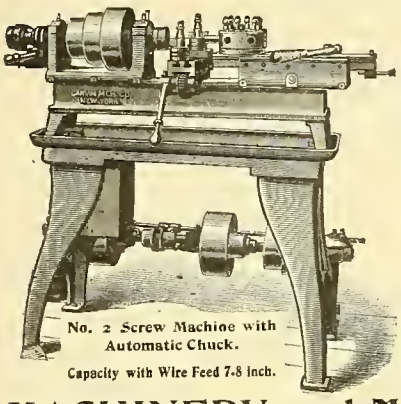

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RANGING IN CAPACITY

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WITH OR WITHOUT

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As the Size and Style of Work Require

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ALTERNATING AND DIRECT CURRENT.

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Electric Appliance Co.
Partrick & Carter Co.

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Westinghouse El. & Mfg. Co.

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Samson Cordage Wks.

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Eastern Electric Cable Co.
Metropolitan Electric Co.
Moore, Alfred F.
National Cond. & Cable Co.
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Washburn & Moen Mfg. Co.

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Chicago Edison Co.
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Electrical Exchange, The.
Ft. Wayne Elec. Corporation.
Hodge, Walsh & Loring.
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National Electric Co.
Warren Electric Mfg. Co.

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Brush Electric Co.
Bryan & Humphrey.
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Card Electric Co.
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Eddy Elec. Mfg. Co.
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Siemens & Halske Elec. Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse Elec & Mfg Co.

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Mansfield Temp. Copper Co.

Copper Wires.
American Electrical Works.
Besly & Co., Chas H.
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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Samson Cordage Wks.

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Int. Correspond. Schools.

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Commercial El. Supply Co.
Perkins Elec. Switch Mfg. Co.
Spring Park Laboratory.
Swett & Lewis.

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Commercial El. Supply Co.
Electric Appliance Co.

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Elec. Eng. & Supply Co.
Ft. Wayne Elec. Corporation.
General Elec. Co.
Gilmore El. & Mfg. Co.
Hart & Hegaman Mfg. Co.
Hopa Electric Appliance Co.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Reynolds, S. K.
Westinghouse El. & Mfg. Co.

Dises.
Smith & Co., Thos.

Dynamos.
Ahlm-Edwards El. Co.
American Engine Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Siemens & Halske Elec. Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Economizers, Fuel.
Fuel Economizer Co.

Electric Heaters.
American El. Heater Co.
American El. Heating Corp.
Johns, H. W., Mfg. Co.

Electric Meters.
American El. Meter Co.

Electric Railways.
Brush Electric Co.
General Electric Co.
Krotz, Allen & Kelly.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

Electrical and Mechanical Engineers.
Bain, Foree.
Bryan & Humphrey.
McRae, A. L.
Patitz, A. M.
Pratt, Chas. A.

Electrical Instruments.
Automatic Cir. Breaker Co.
Central Electric Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Hope Electric Appliance Co
Keystone El. Instrument Co
Paiste Co., H. T.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Electrical Specialties.
Automatic Cir. Breaker Co
Central Electric Co.
Commercial El. Supply Co.
Metropolitan Electric Co.
Paiste Co., H. T.
Peru Elec. Mfg. Co.

Electrical Woodwork.
Lever, C. H. Mfg. Co.

Electro-Plating Mach'y.
Besly & Co., Chas. H.
General Electric Co.

Engines, Gas.
Otto Gas Engine Wks.
Van Duzen Gas & Gso. Eq. Co.
Van Horne, Burger & Co.

Engines, Steam.
American Engine Co.
Ball Engine Co.
Philadelphia Eng. Works.

Fan Outfits.
Bates & Bro., D. L.
Central Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Emerson El. Mfg. Co.
Hunter Fan & Motor Co.
Schneider Mfg. Co.
Westinghouse El. & Mfg. Co.

Feed Water Heaters.
Davis & Son, I. B.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Files.
Barnett Co., G. & H.

Fixtures, El. & Comb'n.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.

Fuse Wire.
Central Electric Co.
Chicago Fuse Wire & Mfg. Co.
Commercial El. Supply Co.
Electric Appliance Co.

Gaskets.
Johns, H. W., Mfg Co.
Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Bogart, A. L.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Ganor & Colburn.
Hodge, Walsh & Loring.
Hope Electric Appliance Co.
International Elec. Co.
Metropolitan Electric Co
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Hemingray Glass Co.

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Empire China Works.
Gilmore El. & Mfg. Co.
Hemingray Glass Co.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Locke, Frad. M.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Alternating.
Puritan Electric Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Sunbeam Inc. Lamp Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Valle

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Mansell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co.
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El. Supply Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Paarless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Hart, C. S.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.
National Electric Co.

Rheostats.
Am. El. Heat. Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co.

Second-Hand Machin'y.
Chicago Armature Co.
Cornman Co.
Electrical Exchange, The.
National Electric Co.

Shades.
Muir & Son, Thos.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.
Whitney Elec. Inst. Co.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.,
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Farr Tel. & Cons. Sup. Co.
Kusel, D. A. Tel. Mfg Co.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tel. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Chicago Gen'l Fixture Co.
Commercial El. Supply Co.
Elec. Eng. & Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

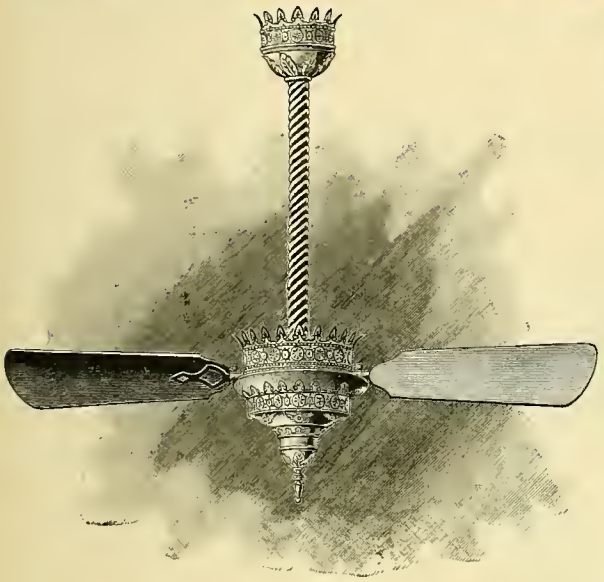
Water Wheels.
Am. Impulse Wheal Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.
Spring Park Laboratory.
Swett & Lewis.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

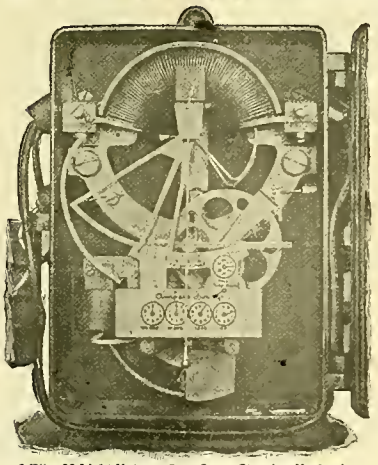
SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



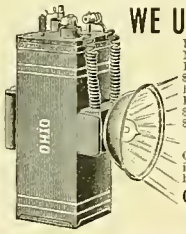
3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

It gives a light that's white and bright,
And two cents is the cost per night.



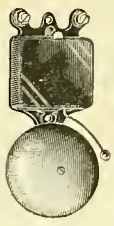
WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
$8 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.50

Agents Wanted.

Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.

Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.



"H" BELL
EASY RINGER.
PIVOTED ARMATURE,
DOUBLE ADJUSTMENT.
SEND FOR CATALOGUE.
HUEBEL & MANGER,
MANUFACTURERS,
290 Graham St., Brooklyn, N. Y.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
PITTSBURG, PA.

New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

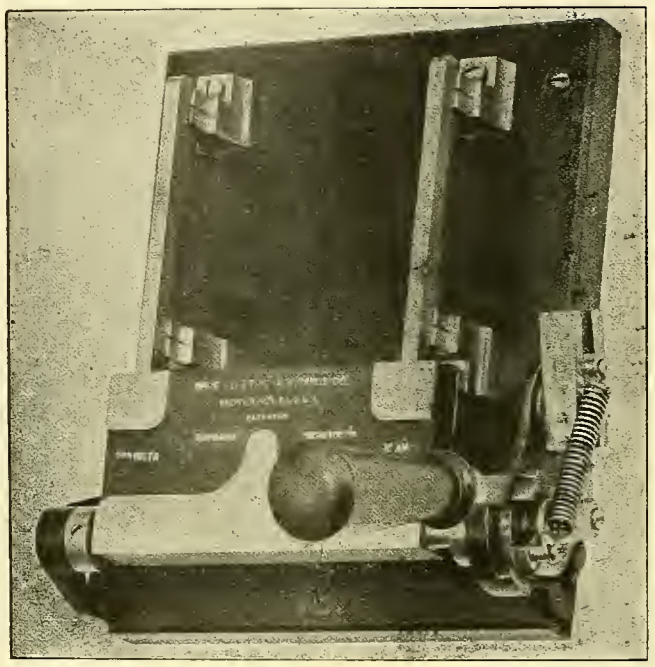
Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



INSTANTANEOUS

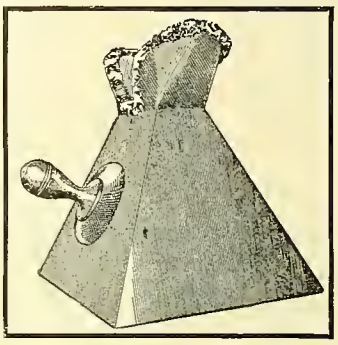
"Make and Break" Safety Knife Switches.

All Voltages. Approved by National Board of Fire Underwriters. Send for Catalogue.

Hope Electric Appliance Co.,

PROVIDENCE, R. I.

FLUOROSCOPES AND SCREENS



Of the recently discovered Fluorescent Crystals are being used by a large number of physicians, hospitals and experimenters, in place of tungstate of calcium and other salts, as they accomplish the result of showing each image undimmed by previous exposure or phosphorescence, make clear the most vague shadows which can not be traced when calcium of tungstate is used, and are absolutely instantaneous in effect.

A leading scientist says: "I find the Fluoroscopes and Screens of this Crystal an improvement over all others that I have used."

Made only by the

SPRING PARK LABORATORY,

JAMAICA PLAIN, MASS.

Also Complete X-Ray Apparatus, Scientific and Electrical Instruments.

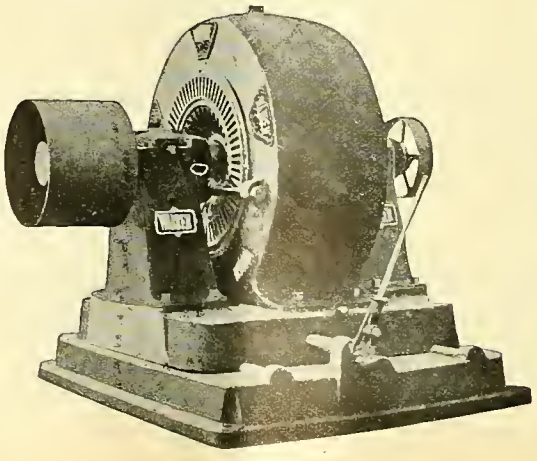
THE WARREN ALTERNATOR.

A DYNAMO without Collector Rings, or Commutator; without Brushes, without Moving Wires, without liability to "burn-out."

MASSIVE AND HEAVY, BUT EXTREMELY COMPACT.

Made for continuous runs without attention and proportioned to run up to an enormous overload without wasting energy in heating any part.

NOISELESS IN OPERATION.
A MONEY EARNER.



THE EMBODIMENT OF SIMPLICITY AND DURABILITY.

THE

MODERN DYNAMO

FOR CENTRAL STATION WORK.

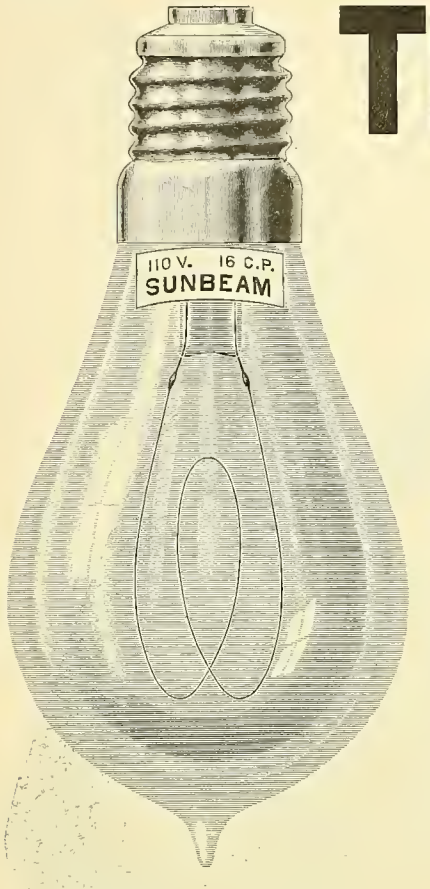
Warren Electric Manufacturing Company,

SANDUSKY, OHIO.

"Ad." Studio
Commercial
Electrical
Supply
Co.,
St. Louis.

Until You Get

Our prices on Fans (every make) you don't know the market!



The Sunbeam Incandescent Lamp

Has been manufactured for **Seven Years** and during that time it has been recognized by those who have made themselves familiar with all lamps as the **highest grade** lamp made.

This is a full size cut of the **New Type Sunbeam Lamp,** in which is retained all of the good features that have made the Sunbeam lamp so highly regarded by all who have become familiar with it, and improvements have been made that will still further add to its appearance and efficiency.

The letter given below is from one of our first customers, and they have been using our lamps for more than six years.

70-1-97-15 c (2L)

The Cicero Water, Gas and Electric Light Co.
OAK PARK

Telephone No. 50

Oak Park Ill. Dec. 1, 1896.

Sunbeam Incandescent Lamp Co.,
Chicago, Ill.

Gentlemen:-

During the last six months, have made a very thorough and careful test of four kinds of lamps as to efficiency and life. Under the same conditions, we have found the "Sunbeam" to be the highest grade lamp, and to give the best results as to economy and length of service. It gives me great pleasure to be able to inform you of this fact, and the best evidence of our sincerity, is the large orders placed with you during the week.

Very truly yours,

R L Dodge Manager.

The SUNBEAM ELECTRIC RAILWAY LAMP is not equaled. No other electric railway lamp will have so long a life nor retain its brilliancy to the same extent. No other will so well stand the jarring of the car:

71-1-97-15 (2L)

EAU CLAIRE
STREET RAILWAY, LIGHT AND POWER COMPANY.
NO. 318 GIBSON STREET.

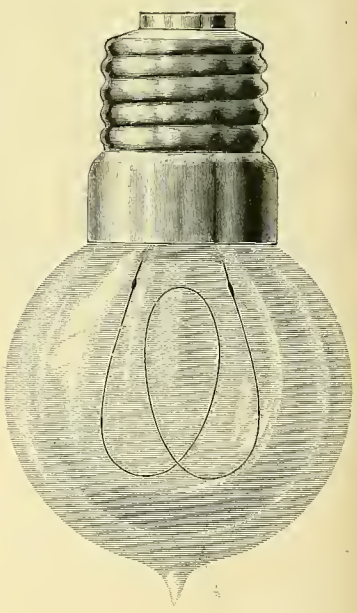
EAU CLAIRE, WIS., Dec 9 1896

Sunbeam Incandescent Lamp Co,
Chicago Ills,
Gentlemen: -

We have used the Sunbeam Electric railway lamps in our Street Car Circuits during the past two years and after a comparative trial with other lamps have found them to be the most satisfactory available for such service. They seem particularly well fitted to stand the strain and variation incident to the "ups and downs" of the Street Railway business.

Yours Truly
Eau Claire Street Railway Light & Power Co.
By. Geo R Wheeler
Treasurer

Lamps of Small Candle Power.



We surpass in the manufacture of lamps of small candle power, consuming a small amount of energy. These lamps are for use in signs and in decorative lighting. Also are useful in many places in residence lighting.

ADDRESS ALL COMMUNICATIONS TO

The Sunbeam Incandescent Lamp Co.,

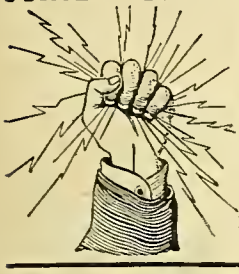
WESTERN ELECTRIC BUILDING, CHICAGO.

Or Western Electric Co., New York.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

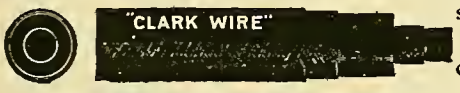


BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.



All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

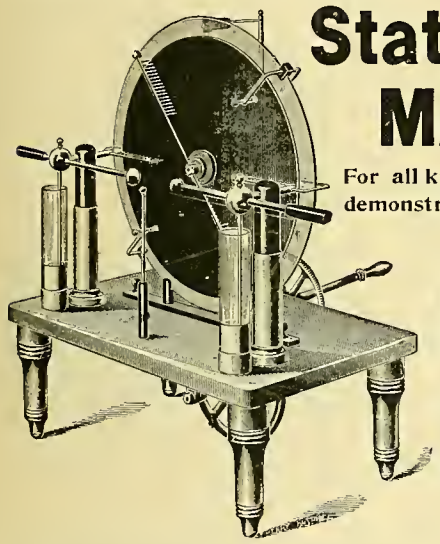
Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Manager.
HERBERT H. EUSTIS, Pres. and Electrician.

61-63 Hampshire Street,
BOSTON, MASS.



Static X-Ray MACHINE

For all kinds of X-Ray work and demonstrations in Static Electricity.

SINGLE AND DOUBLE PLATE MACHINES.

Ruhmkorff Coil Outfits, Crookes Tubes, Fluoroscopes, Photo-Screens, and a complete line of X-Ray apparatus. Our outfits are the cheapest and best that can be procured.

Send for Catalogue B.

Swett & Lewis,

Successors to G. A. FREI & CO.,
Electrical and Photographic Supplies,
11 BROMFIELD STREET,
BOSTON, MASS.

J.G. Brill Company, Philadelphia,

MANUFACTURERS OF

ELECTRIC CARS AND TRUCKS,
SOLID FORGED FRAME TRUCKS,
TRUCKS FOR 4-WHEEL CARS.

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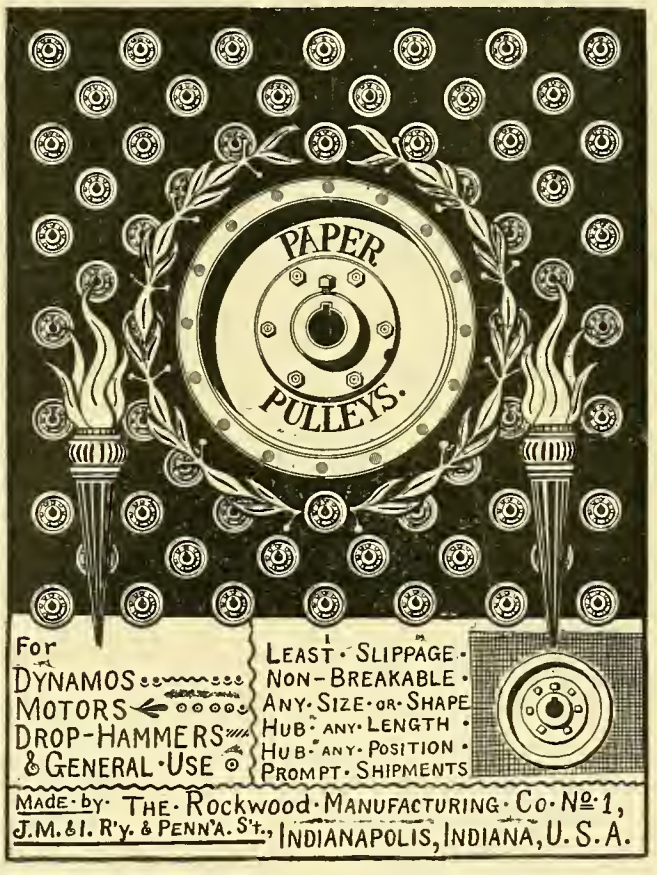

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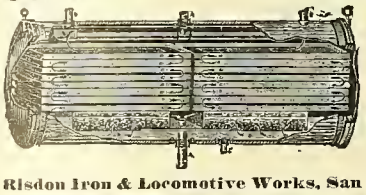

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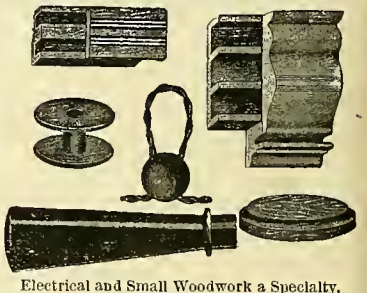

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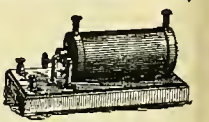

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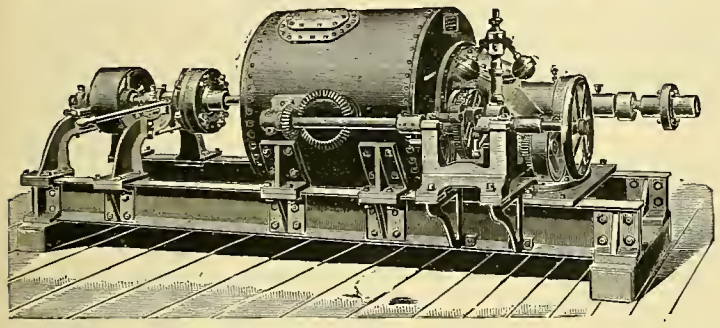

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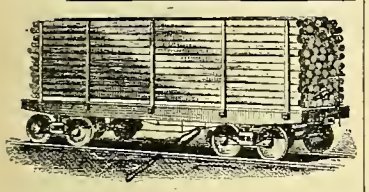

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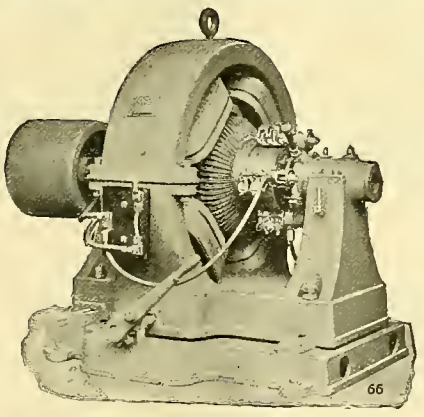

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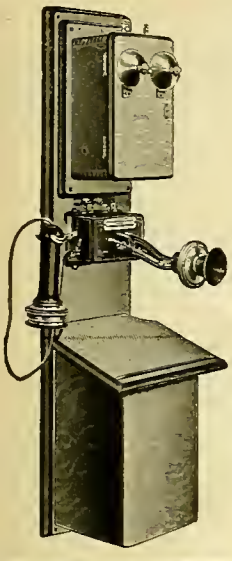

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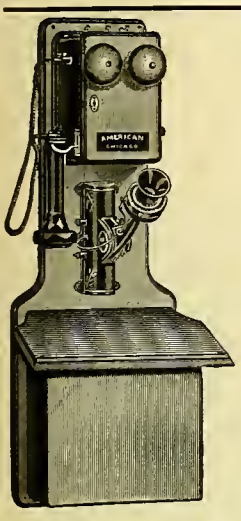

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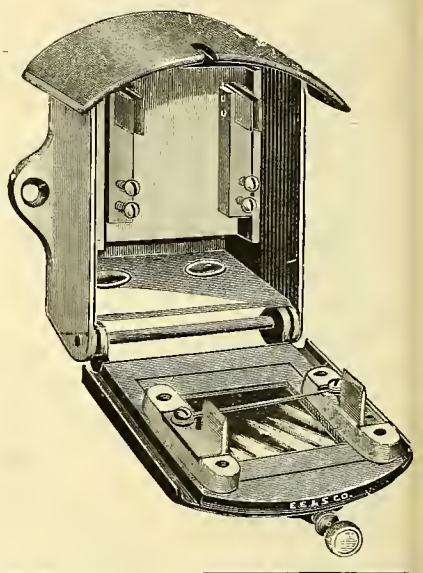

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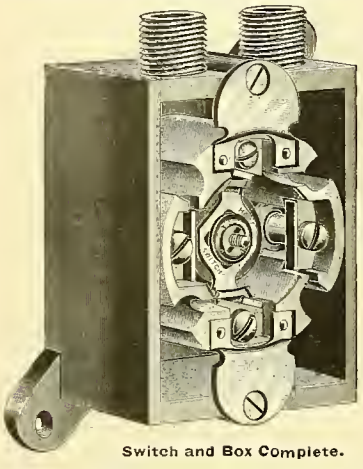

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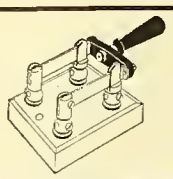

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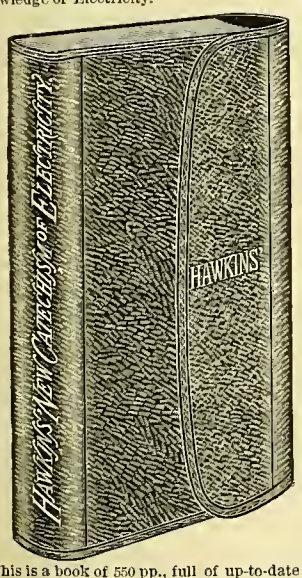

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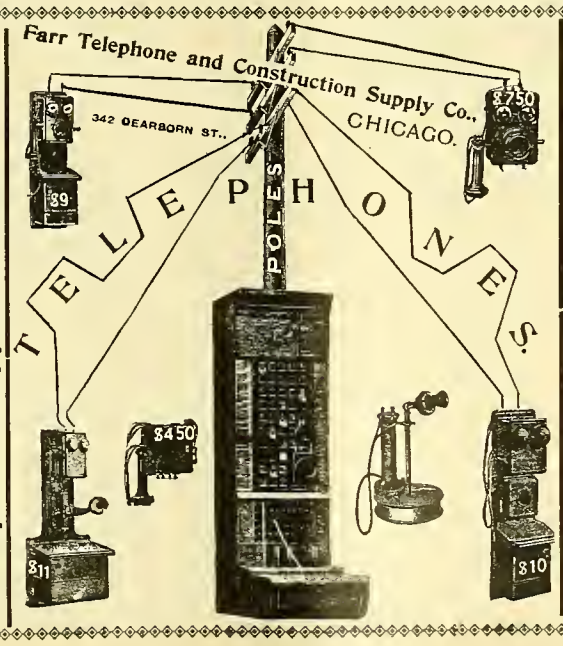

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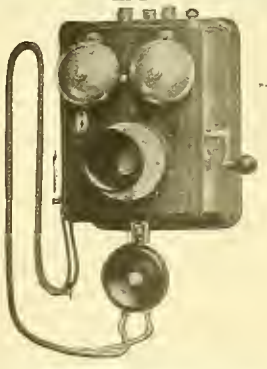

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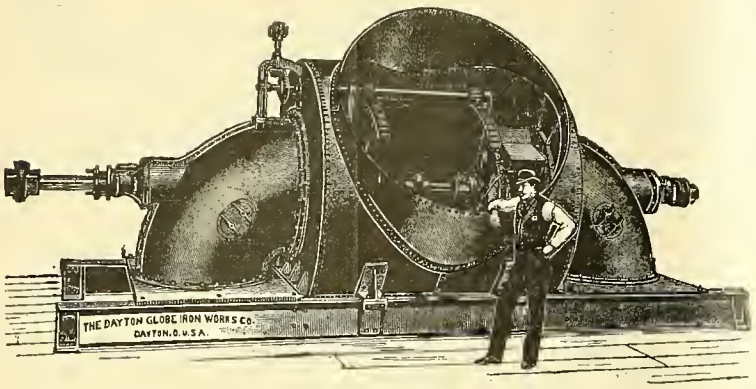

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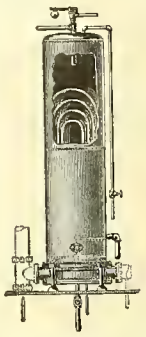

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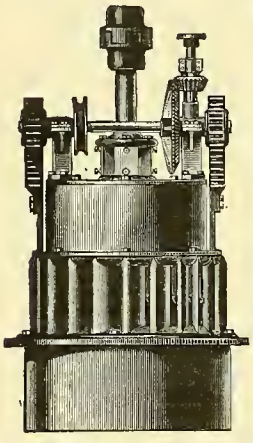

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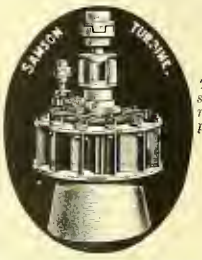

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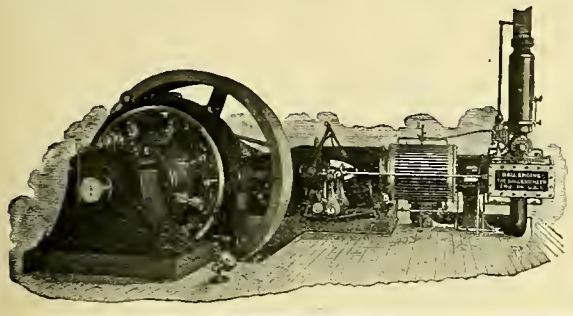

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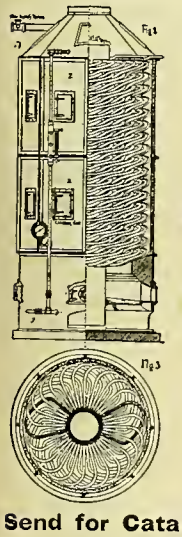

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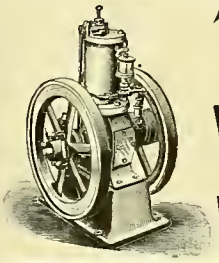

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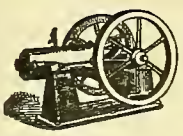

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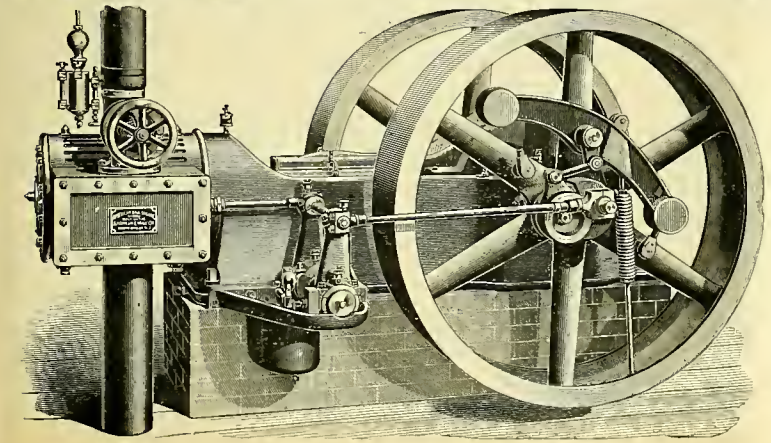

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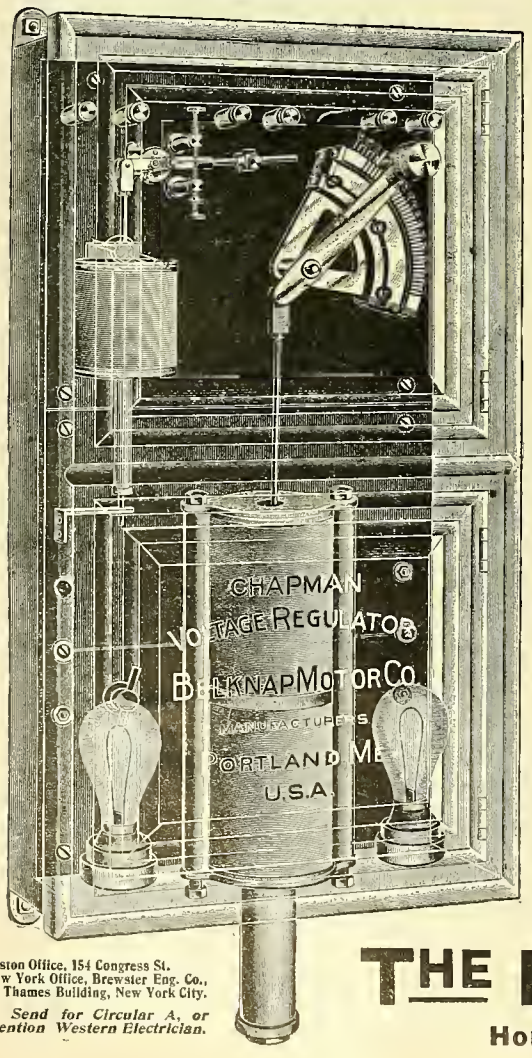

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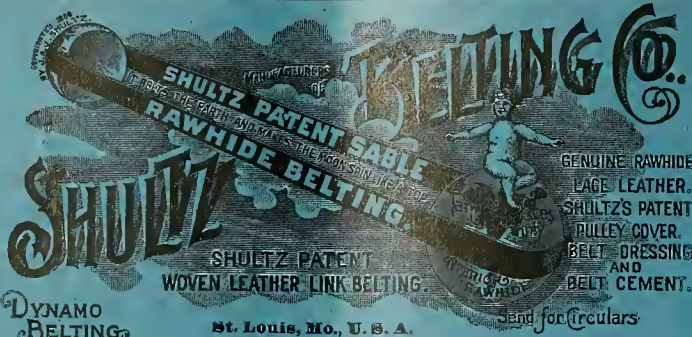

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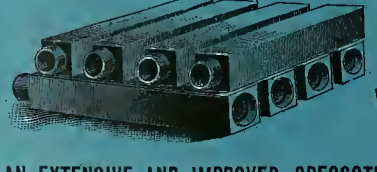

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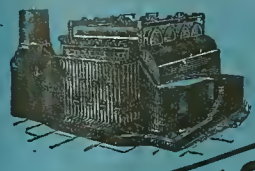

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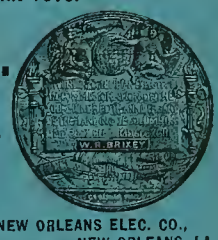

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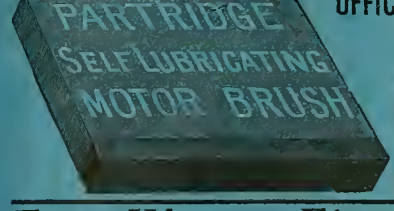

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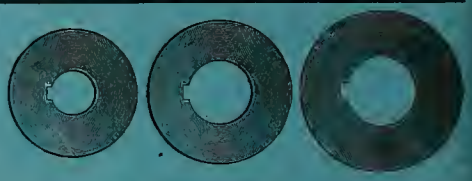

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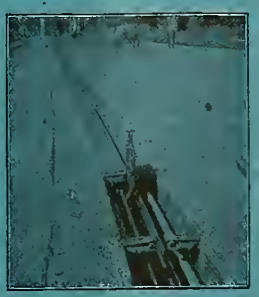

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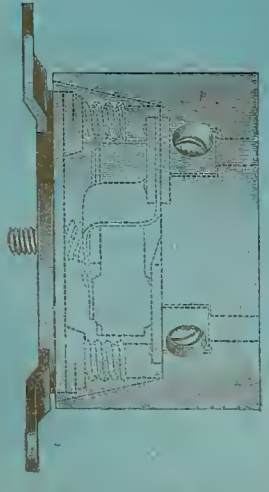

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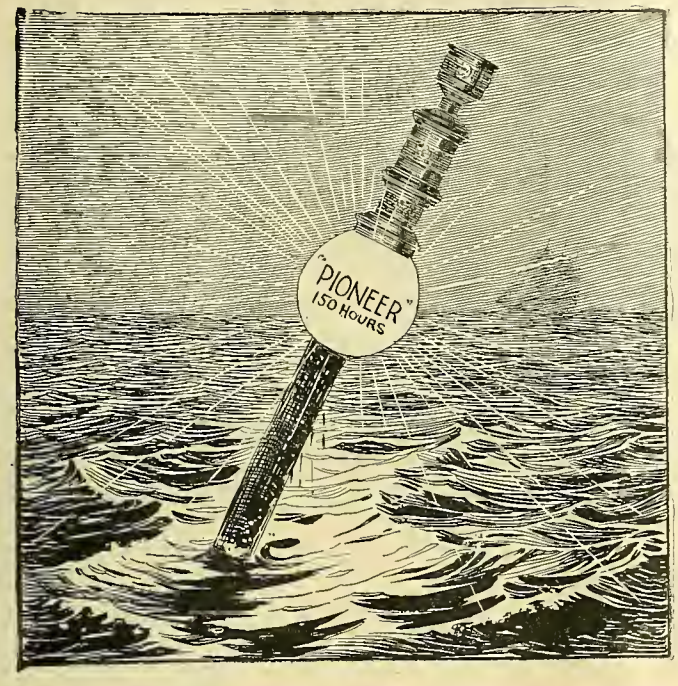

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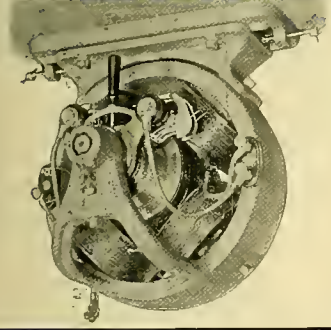

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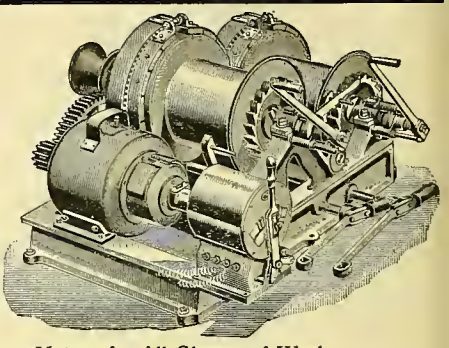

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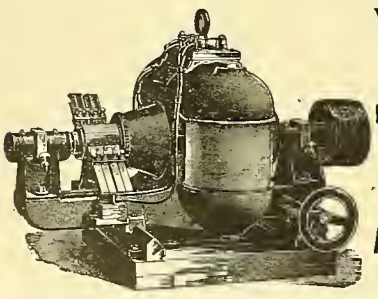

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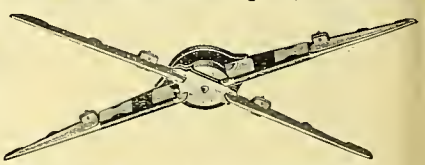

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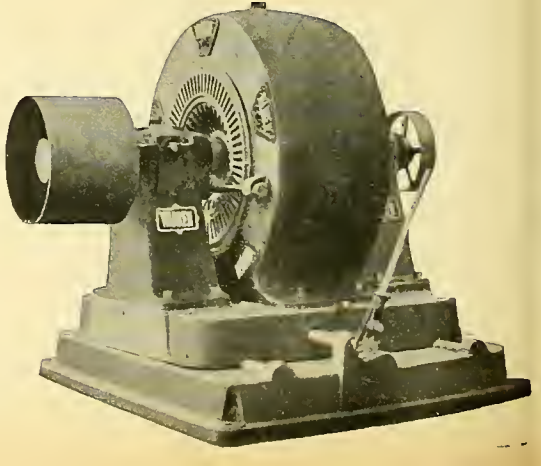

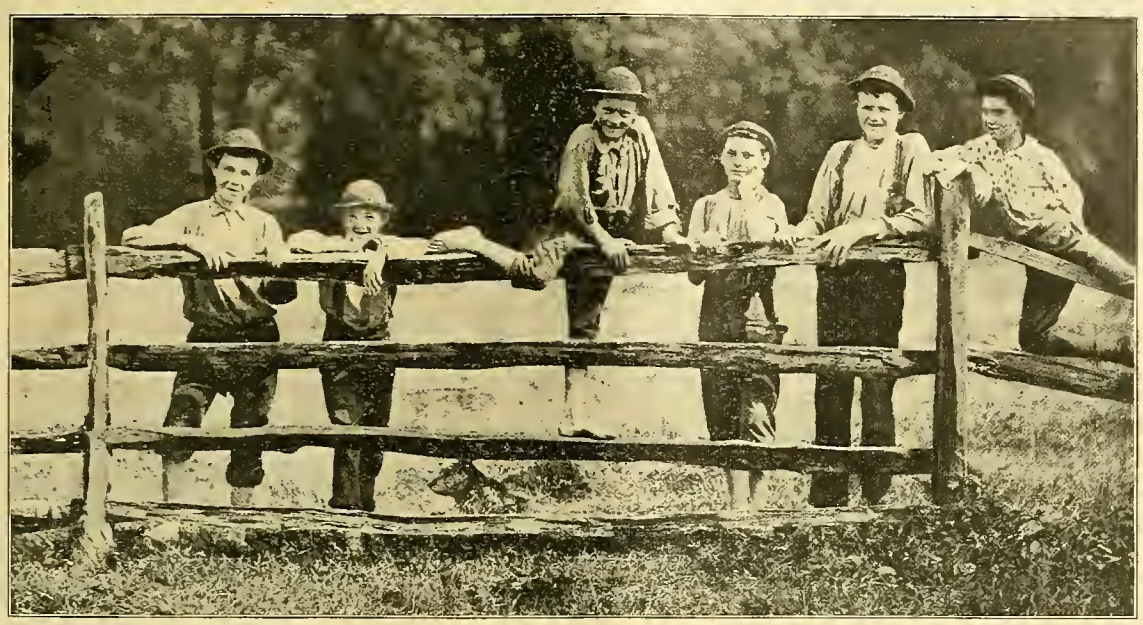

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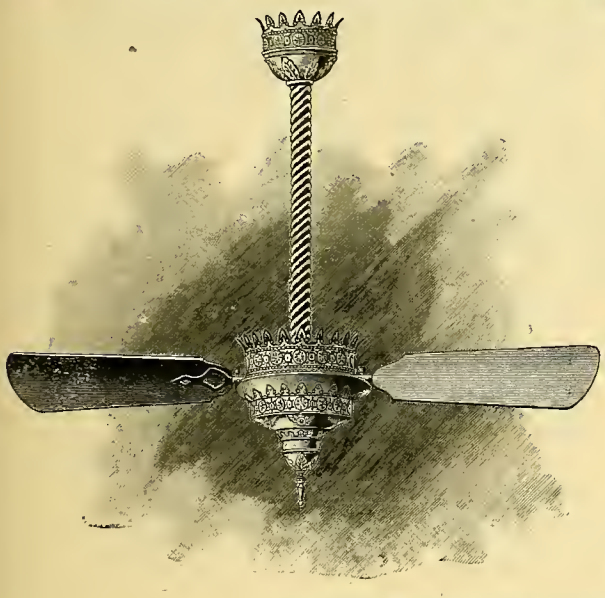

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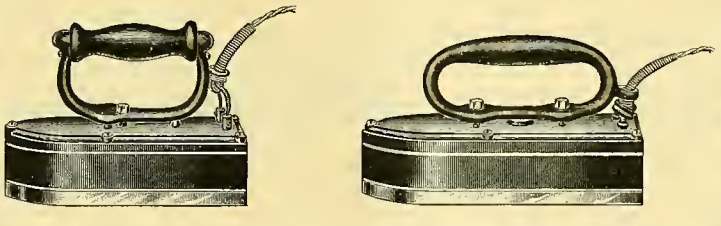

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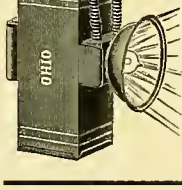

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Sent us word that unless we came in they would "bust" us. Keep your eye on us and we predict that when the battle is over it will be found that it is the trust which is "busted," and not us.

If this is the case the less contracts you have on hand for combine lamps the better you will be off. Why should you make a contract for trust lamps, anyway? We will sell you lamps in barrel lots for less than their contract price and guarantee them at least equal to any trust lamp made. Also recollect that when the trust breaks (as it is sure to do) we will meet any price which is made or release you from any contract you may have made with us.

In order to keep up the fight we must have orders. Don't wait for someone else to send in the orders. Send in yours.

PRICES:

10, 16 and 20 C. P. Lamps, barrel lots, capped with Edison or Westinghouse bases . . . . **17 Cents.**

T.-H., Brush-Swan, U. S. and Hawkeye bases, 1 cent extra.
Schaffer and Perkins bases, 3 cents extra.

The Warren Electric & Specialty Co.,

WARREN, OHIO,

Manufacturers High-Grade Anti-Trust Incandescent Lamps.

MENTION THE WESTERN ELECTRICIAN.

"THE ELECTRA"

ELECTRA ·TRADE MARK·

HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

The Tuerk Alternating Current Ceiling Fan.

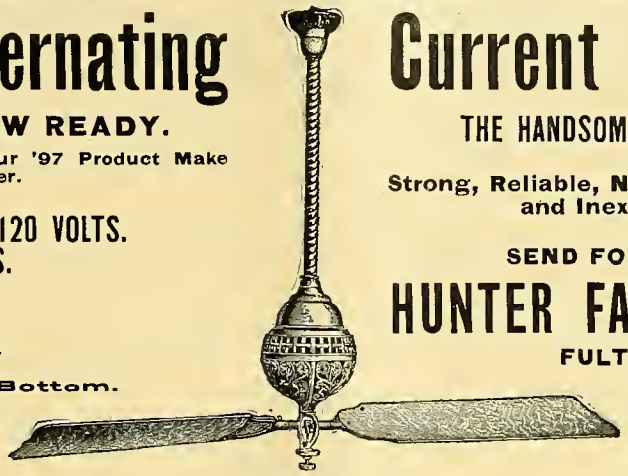
1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.



THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

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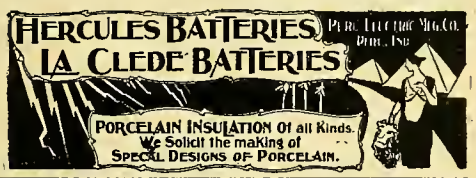
HUNTER FAN & MOTOR CO.,
FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.



ALL Live men read the WESTERN ELECTRICIAN Each Week. Do You?

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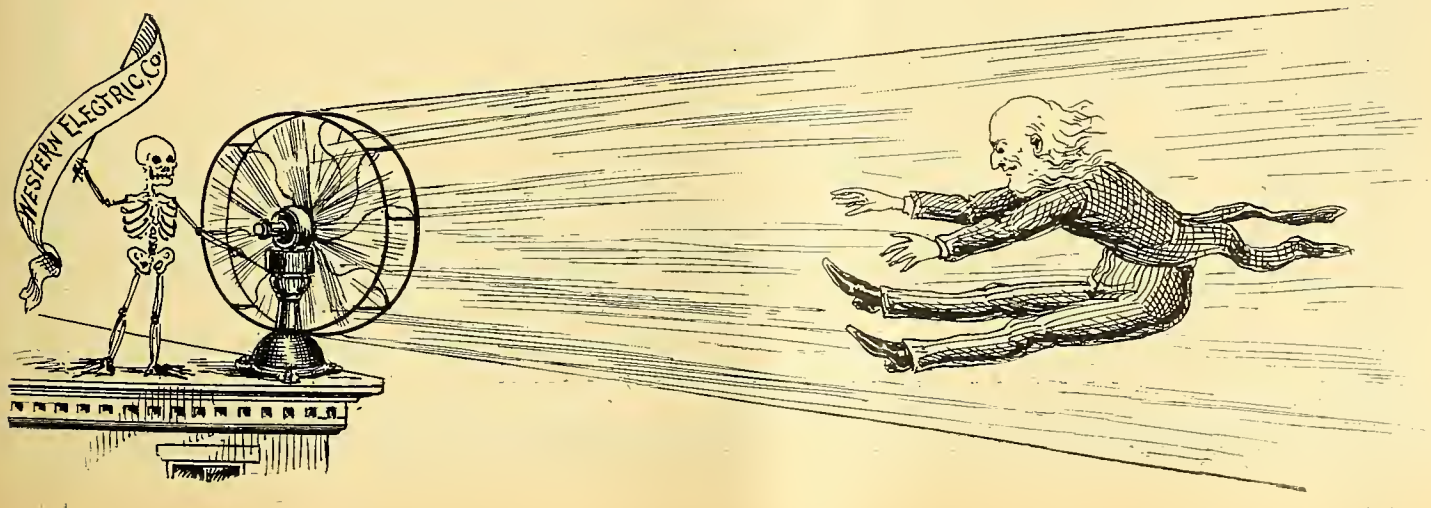
Commercial
Electrical
Supply
Co.,
St. Louis.

"THE BLOW ALMOST KILLED FATHER!"

("IT NEVER FAILED!")

(P. S. Get OUR Prices on this Fan!)



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Phila.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

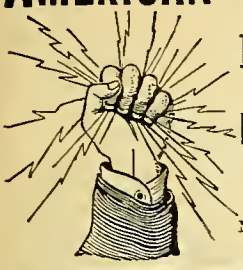
The Scott & Janney Elec. & Mfg. Co.

1707-1709 FILBERT ST., PHILADELPHIA.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE ONLY

WATER-WHEEL GOVERNOR

THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO., WATERVILLE, ME., Jan. 18, 1896.

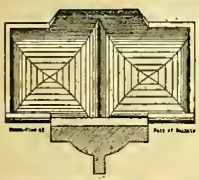
Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

LOMBARD WATER-WHEEL GOVERNOR CO.,

61 Hampshire St., BOSTON, MASS.



THE NEW POWER WHEEL,

THE CAZIN

WATER OR STEAM WHEEL.

FRONT VIEW OF BUCKET.

WILL FURNISH MORE POWER PER CUBIC FOOT OF WATER USED THAN ANY OTHER WHEEL MADE.

SEND FOR CATALOGUE.

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No Sparking Under Varying Load,
No Wear on the Commutator.

90% PURE GRAPHITE.

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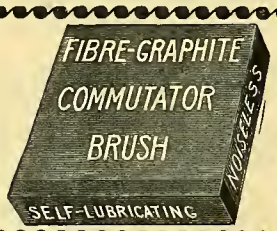

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MANUFACTURERS OF

ELECTRIC CARS AND TRUCKS,
SOLID FORGED FRAME TRUCKS,
TRUCKS FOR 4-WHEEL CARS.

PIVOTAL TRUCKS FOR STEAM AND ELECTRIC SERVICE.

The PERFECT TRUCK, our "No. 27," is safer, easier on rails, easier for passengers and imparts less motion to the car body than any truck ever made.

WE CAN SUBSTANTIATE OUR CLAIMS.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

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BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Scranton.

Patented.

No. 11 DOUBLE GROOVE PONY INSULATOR

HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

HEMINGRAY GLASS CO., Covington, Ky.

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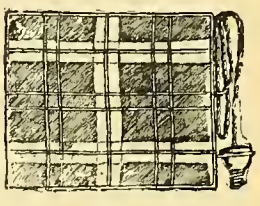
$5.00 $3.00 $5.00

Electric Stew Pan.

Electric Curling Iron Heater.



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Some of our goods which connect to lamp sockets, using from ½ to 2 amperes at 110 volts.

AMERICAN ELECTRIC HEATING CORPORATION.

NEW YORK, 39 CORTLANDT STREET. BOSTON, SEARS BUILDING. CHICAGO, MONADNOCK BLOCK.

$4.00

Electric Stove

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Electric Smoothing Irons.

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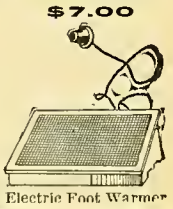

Electric Foot Warmer

WEATHERPROOF WIRE.

AGENCIES:

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WANTED.

Position as superintendent of electric lighting or power plant by man with twelve years' experience in building and operating plants. I can give the best of references as to ability and character. Would be pleased to hear from parties wanting a No. 1 hustler. Address "Hustler," care WESTERN ELECTRICIAN, 510 Marquette Building, Chicago.

WANTED.

To sell an electric light plant located in a growing and prosperous town in Northwest Missouri. It is paying a good profit. For particulars address "Dividend," care WESTERN ELECTRICIAN, 510 Marquette Bldg., Chicago.

WANTED.

A Van Houten & Ten Broeck or a Waite & Bartlett static machine; must be in perfect order and having all recent improvements. T. H. JOHNSON, 245 E. Seventh St., St. Paul.

WANTED.

ARMATURES TO REWIND.

Winders direct from T.-H. and Westinghouse shops. Work guaranteed. Ten years' experience. Light plants installed complete. Send for prices.

HODGE, WALSH & LORING,
531 Delaware, KANSAS CITY, MO.

BIDS.

Bids for lighting the streets and public squares of Oneida, Madison County, N.Y., with electricity for five years, will be received up to 8 o'clock p. m., June 4, 1897. Write to undersigned for specifications.

H. L. BONNEY, Clerk,
Oneida, Madison County, N. Y.

By Order of the Board of Trustees.

BIDS WANTED.

The City of Eldon, Iowa, is in the market for an electric light plant, consisting of 50 k. w. alternator and engine, boiler, building and line of construction for municipal and commercial lighting. Plans and specifications may be seen at the office of **Mayor H. R. BAKER, Eldon, Iowa.**

Bids received until noon, June 10, 1897. City reserves right to reject any or all bids.

FOR SALE.

Second hand Arc Lamps of different manufacture; good as new and thoroughly tested; also, Arc and Incandescent Dynamos and other electrical apparatus.

Always in the market for scrap Dynamos, Motors, Wire, Copper, burned out Incandescent Lamps and Lamp bases, etc.

"SPECIAL"—World's Fair Electric Launch, in first-class condition, CHEAP. Address **THE CORNMAN COMPANY**, 1134 Hamilton St., Cleveland, Ohio.

FOR SALE—CHEAP.

Six 25 amp. 110 volt dynamos, compound wound.
Six five horse power motors, any voltage.
Twelve amperemeters.
Twelve voltmeters. **Write for prices.**

HOLMES, PYOTT & CO.,
13 N. Jefferson St., Chicago.

THE ELECTRICAL EXCHANGE,

166-174 S. CLINTON ST.,
CHICAGO.

Long-Distance Tel. 744 Express.
WRITE FOR PRICES.

FOR SALE.

One 30 h. p., 500 volt iron clad, second hand.
One 25 h. p., 500 volt iron clad, second hand.
One 250 ampere, 220 volt Manchester type, compound wound, new, complete.
One 150 ampere, 220 volt Manchester type, compound wound, new, complete.
One 7½ h. p., 220 volt iron clad motor, new.
One 2 h. p., 220 volt iron clad motor, new.
One ¾ h. p., 220 volt iron clad motor, new.
One 5 h. p., 220 volt Manchester type, second hand.

All the above machines have self-oiling bearings and guaranteed to be as represented. Write for prices.

Also the following:

One 15 light arc dynamo, new type Excelsior.
One 7 light arc dynamo, old type Excelsior.
Two 10 light arc dynamos, old type Bain.
Fifty double carbon Excelsior arc lamps.
Ten single carbon Rushmore arc lamps.
Nine single carbon Bain arc lamps.

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14 and 16 North Canal Street, Chicago.

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A College of Engineering. Mechanical, Electrical, Civil Engineering, Chemical courses. Well endowed. Extensive Shops. Modernly equipped Laboratories in all Depts. Expenses low. 15th year. For catalogue address C. L. MEES, President, Terre Haute, Ind.

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Engineers and Contractors for Electric Power Stations.

Sole owners of patents controlling the "ARNOLD SYSTEM" of power station construction.

Reduction in first cost, economy and greater reliability in operation. Write for information.

Map of the United States.

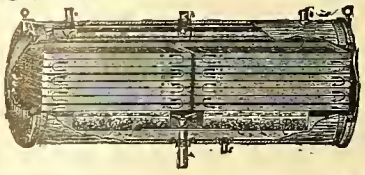
A large handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of fifteen cents in postage by P. S. EUSTIS, Gen'l Pass. Agent, C., B. & Q. R. R., Chicago, Ill.

Scrap Copper Wire Wanted.

If you have any **Old Copper Wire** of any description to dispose of, it will pay you to communicate with us, as we are at all times in the market for any quantity of **Scrap Copper Wire**, at the highest market values. We pay cash and send prompt returns. We are also supplying the electrical trade with our high grade **Babbitt, Cotton Waste, Solder, Etc.** Please communicate with us.

SWARTS METAL REFINING CO.,
20 N. Desplaines Street, CHICAGO ILL.

Stilwell's Patent LIVE STEAM-FEED Water Purifier.



Removes all Impurities.

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New Steel Passenger Steamers

The Greatest Perfection yet attained in Boat Construction—Luxurious Equipment, Artistic Furnishing, Decoration and Efficient Service, insuring the highest degree of

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FOUR TRIPS PER WEEK BETWEEN

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LOW RATES to Picturesque Mackinac and Return, including Meals and Berths. From Cleveland, $18; from Toledo, $15; from Detroit, $13.50.

DAY AND NIGHT SERVICE.

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Connecting at Cleveland with Earliest Trains for all points East, South and Southwest and at Detroit for all points North and Northwest.

Sunday Trips June, July, August and Sept. Only.

EVERY DAY BETWEEN

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Send for Illustrated Pamphlet. Address
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The Detroit & Cleveland Steam Nav. Co.

"AMERICAN" STORAGE CELLS

ARE THE BEST. Send for Descriptive Circular.

Absolutely Non-Infringing.
Protection Guaranteed.

AMERICAN BATTERY CO.,
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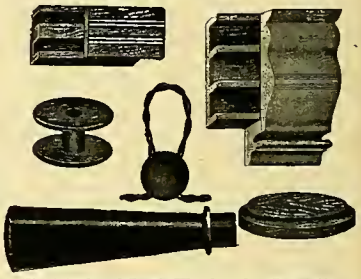
Anchor or Toggle Bolt.

PATENTED OCT. 29, 1895.
TENSILE STRENGTH, 870 LBS.



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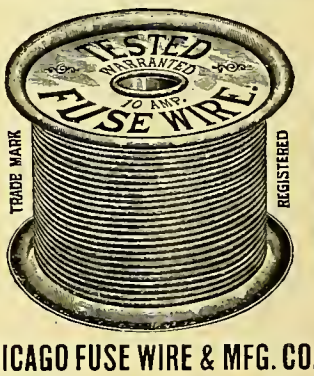
FUSE WIRE AND LINKS FOR ALL SYSTEMS.

Correct Carrying Capacity. Absolutely Uniform.



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INTERNATIONAL ELECTRIC CO.,

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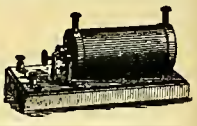
New York.

Ruhmkorff Induction Coils,



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Fully describes in plain terms how to perform experiments with the X-Ray Outfit. Tells what electrical apparatus is needed and how to manipulate it. Illustrations show clearly how to connect up the Crookes Tube, the Ruhmkorff Coil, and how to run them, either by batteries or electric light currents. How to make an X-Ray Outfit very cheaply, including a Fluoroscope.

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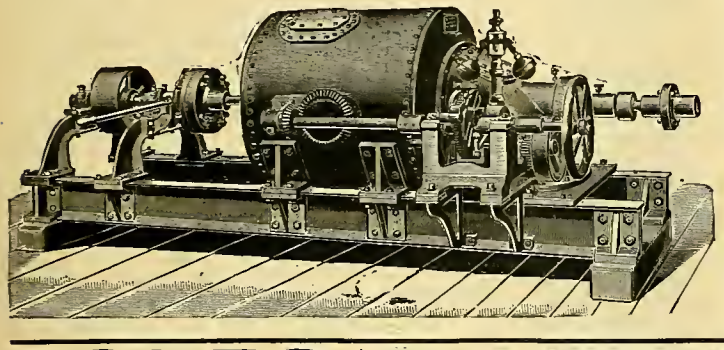

Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter,** being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

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Risdon Iron & Locomotive Works, San Francisco, Cal., Pacific Coast Agents.

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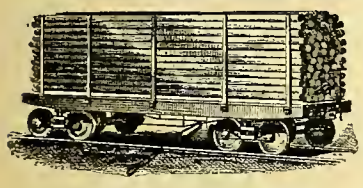

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Pine painted cross arms and Oak pins. Get our prices for delivery at any destination. Six sorting yards, our Monroe yard being most Southern and Eastern in Michigan. Our card: A1 poles and good despatch.

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You can obtain a pack of best quality playing cards by sending fifteen cents in postage to P. S. EUSTIS, Gen'l Pass. Agent, C., B. & Q. R. R., Chicago, Ill.

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WHITE CEDAR POLES And STREET CAR TIES.

Wholesale Producers.

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Write for Prices on **LIVE CEDAR POLES** —TO— Cyrus S. Hart, OCONTO, WIS.

Cedar Poles at First Hands.

We can supply you with anything in the cedar line. Write for delivered prices.

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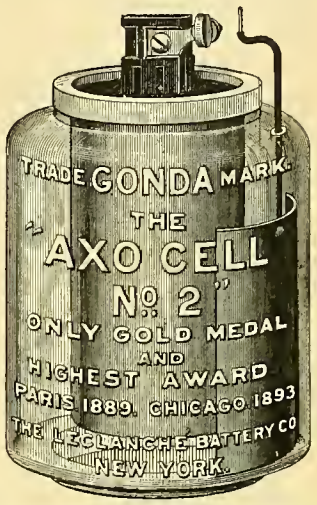
Our new catalogue of Electrical Books. Contains 100 pages, listing all electrical books to date of publication. Send for a copy, mailed free to any address. Electrician Publishing Co., Suite 510 Marquette Bldg., Chicago.



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SEND FOR CIRCULAR AND PRICES.

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The Bullock Electric Mfg. Co.,

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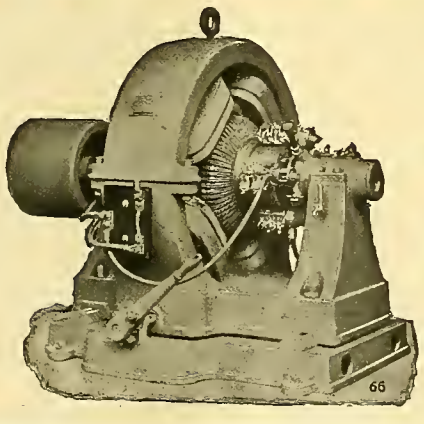
ELECTRIC LIGHT AND POWER PLANTS, AND SLOW SPEED MOTORS.



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The Best of Incandescent Lamps for 12 cents each.

Send us your burned-out lamps and we will return them at the above price and GUARANTEE them to be equal to the best.

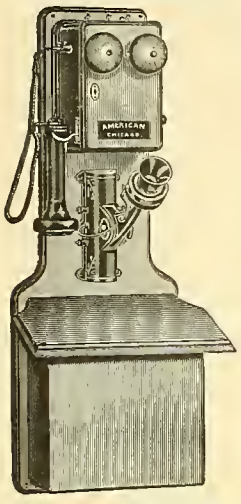
We have a good filament. We procure a vacuum superior to the mercury process.

We renew only those bulbs which have not lost their vacuum, and thus proven that they are without flaw.

We thoroughly clean the bulbs and tighten the loose collars.

Lamps to be renewed should be sent by FREIGHT, as we pay charges to our factory. Be sure your name accompanies shipments and advise us by letter of voltage, base, efficiency and candle power desired.

Lynn Incandescent Lamp Co., Lynn, Mass.



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325 exchanges, aggregating 60,000 telephones, in use. Three years service. Write for our 1897 catalogue showing new types and prices.

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Adjustable Arm 'Phone for Exchange and Toll Line Work. Write for prices.

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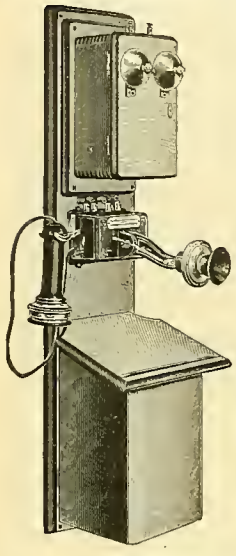

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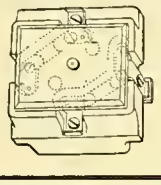

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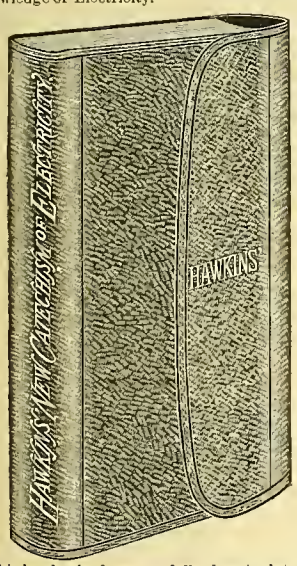

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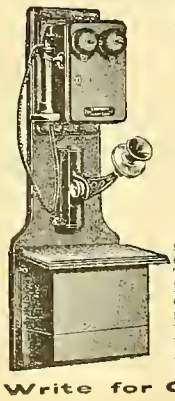

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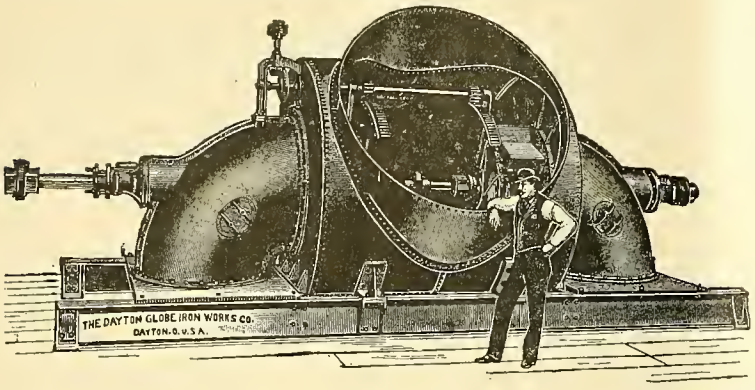

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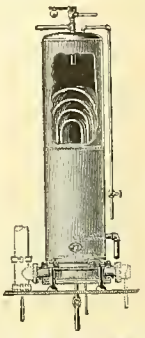

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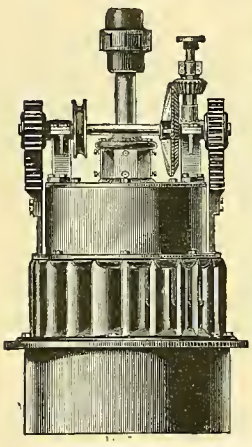

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⅞	15.04	138.12	155 03	223.61	84 55
¾	15.11	127.67	133.24	191.06	83.68
⅝	15.88	131.50	112.65	162.80	80.25
½	16 47	126.87	90.04	127.73	75.95

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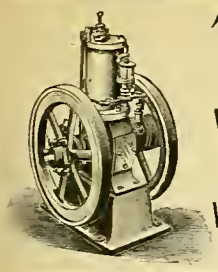

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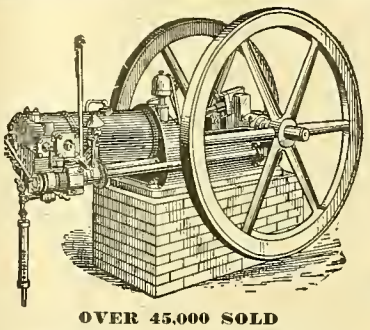

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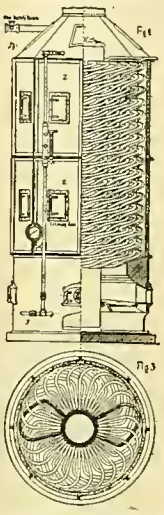

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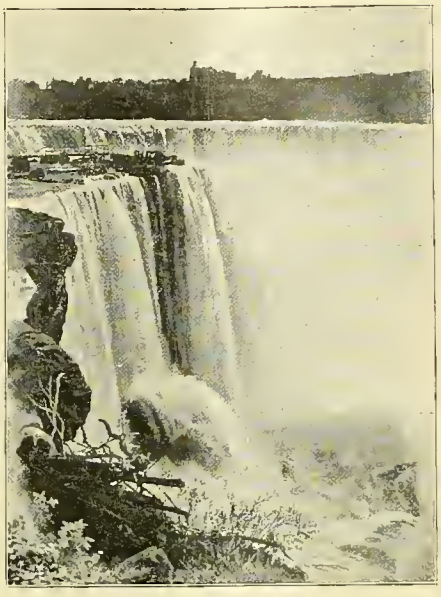

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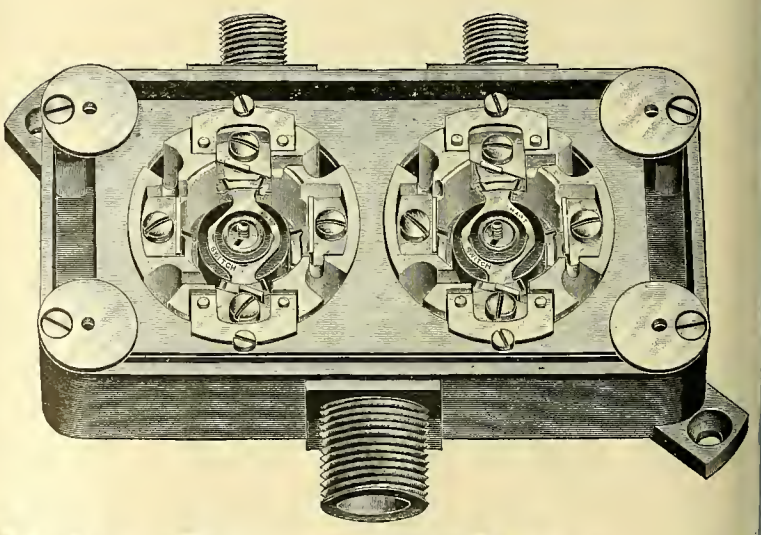

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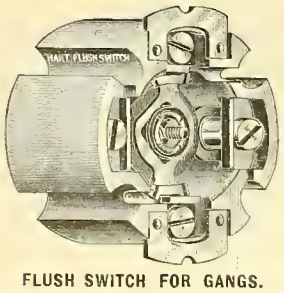

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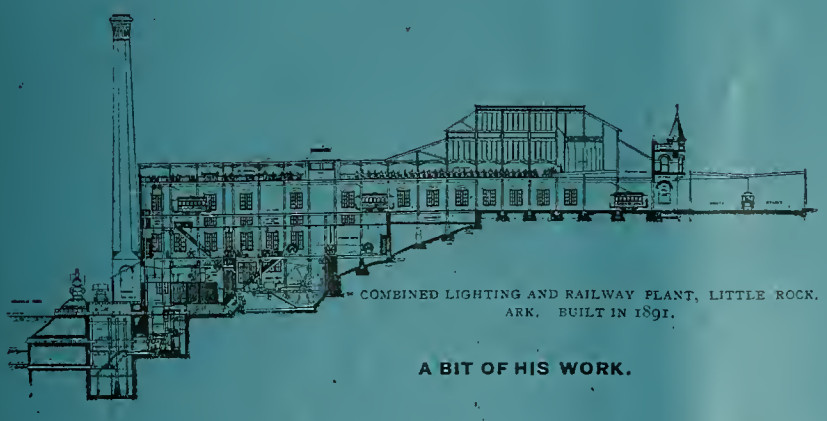

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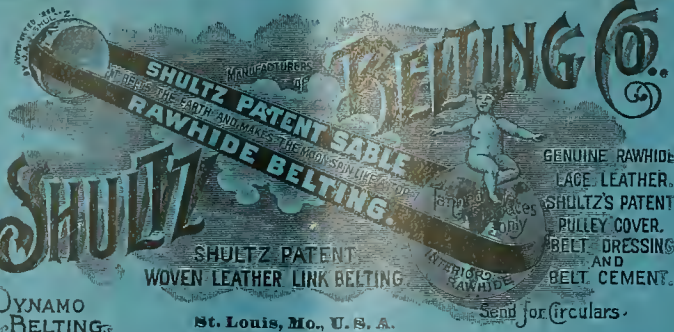

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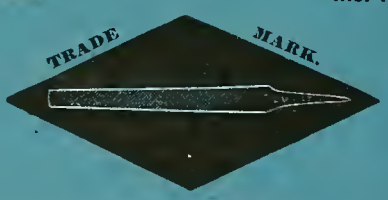

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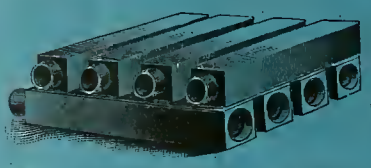

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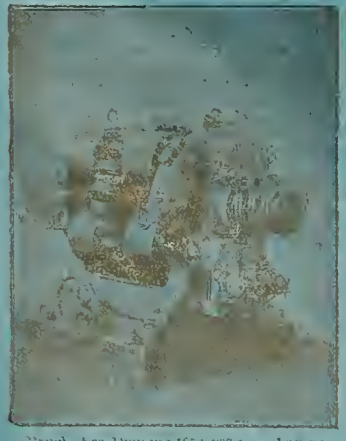
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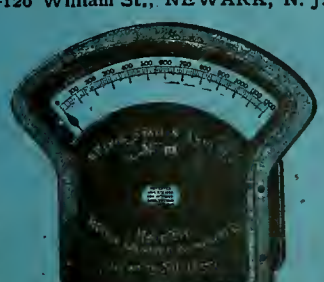

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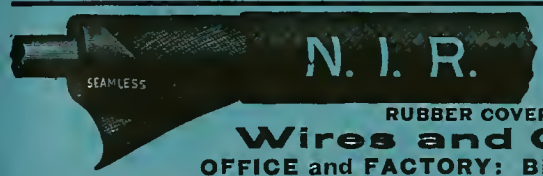

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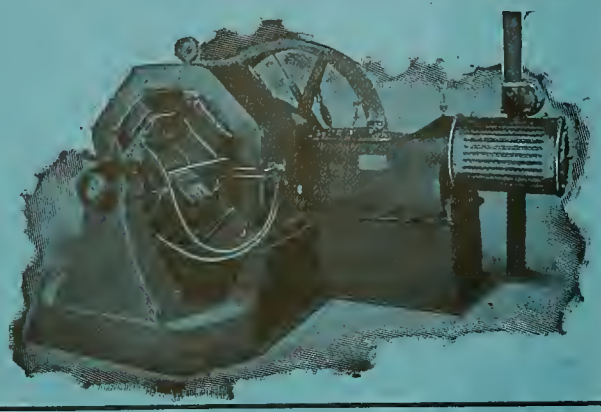

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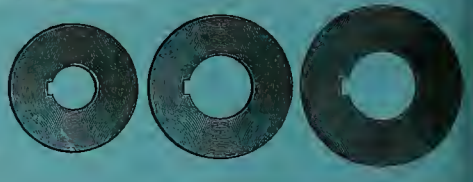

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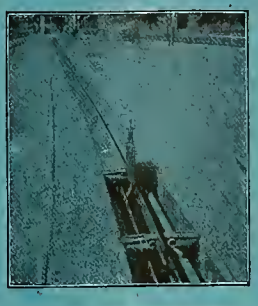

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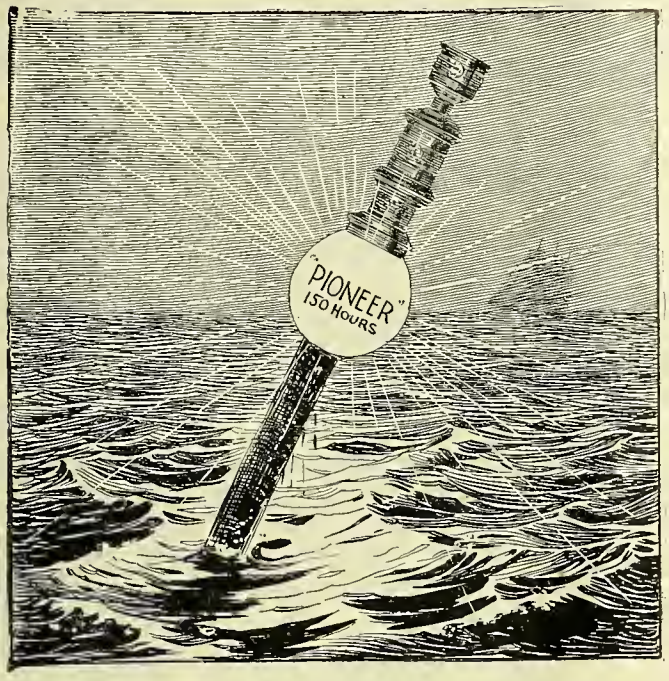

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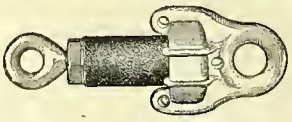

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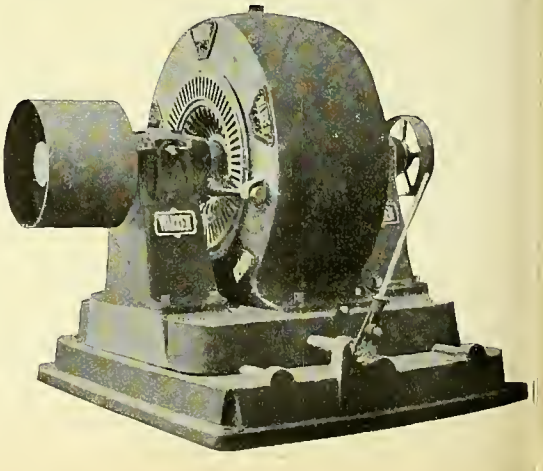

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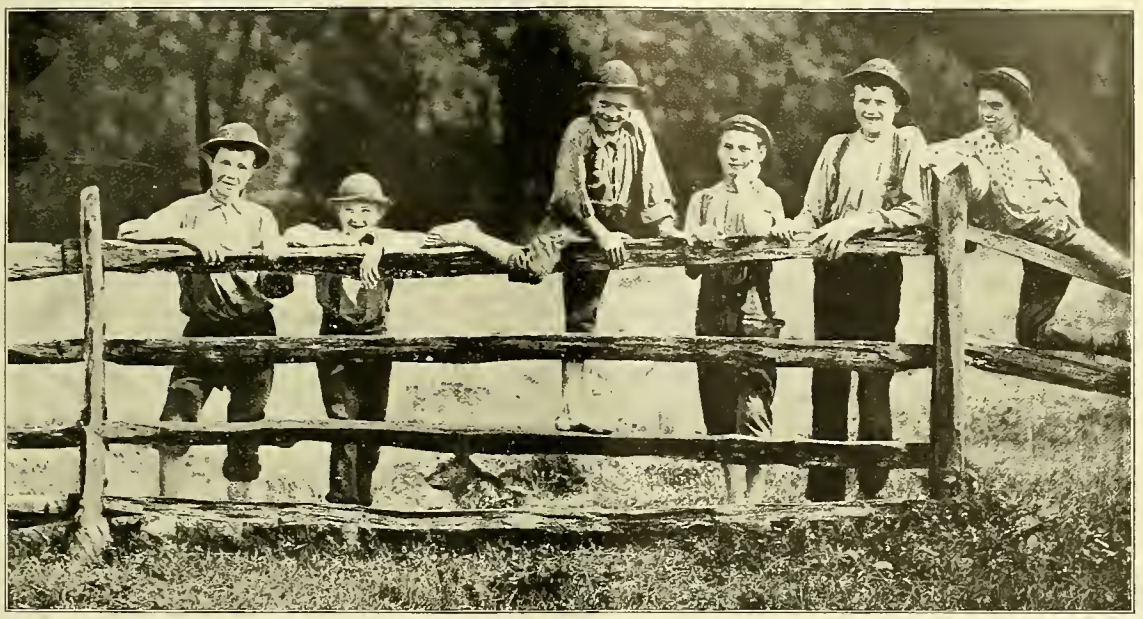

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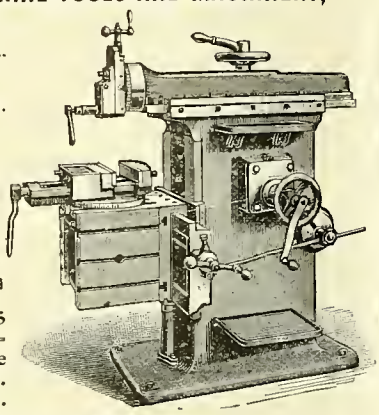

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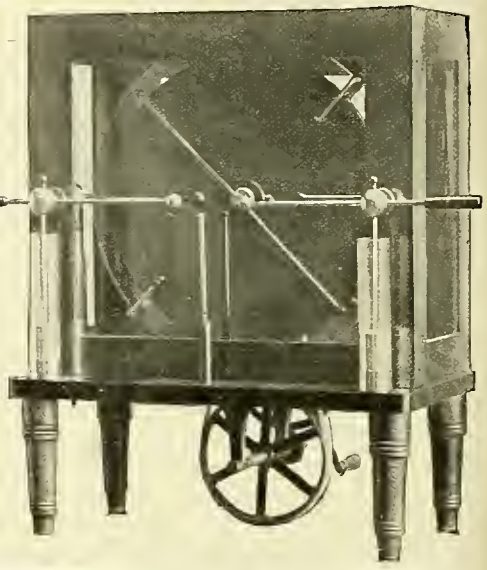

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Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Genor & Coiburn.
Hodge, Walsh & Loring.
International Elec Co.
Metropolitan Electric Co
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.
Hemingray Glass Co

Gov'nors, Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Empire China Works.
Hemingray Glass Co.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Locke, Fred. M.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Alternating.
Puritan Electric Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.
Westinghouse El. & Mfg. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co., The.
Stilwell-Bierce Smith-Valle

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El Supply Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Keystone Electric Co
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarta Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.
National Electric Co.

Rheostats.
Am. El. Heat. Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co.

Second-Hand Machin'y.
Chicago Armature Co.
Cornman Co.
Electrical Exchange, The.
National Electric Co.

Shades.
Muir & Son, Thos.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
Farr Tel. & Cons. Sup. Co.
Kusel, D. A. Tel. Mfg Co.
Lockwood T. & T Co. of Am.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Elec. Eng. & Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co., J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

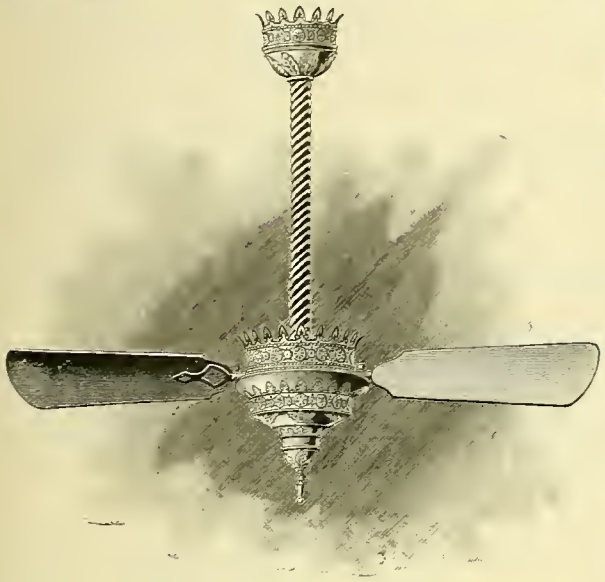
Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C. Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.
Swett & Lewis.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

Any of Our Fans Furnished with Four Blades if so Ordered.

SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

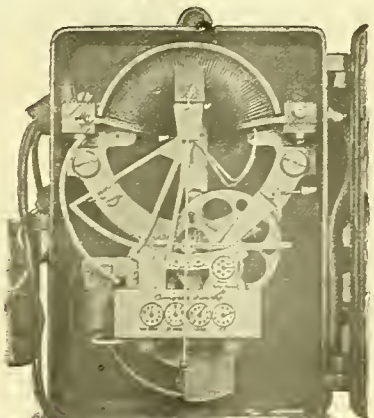
DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

Agents for Canada: CANADIAN GENERAL ELECTRIC CO., 65-71 Front St. West, Toronto, Ont.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.

Send for circulars and price lists.



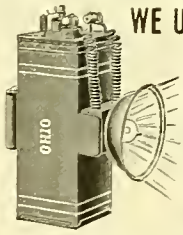
3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

PHILADELPHIA, PA.

It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
$8 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	29.00
$1.25 Bicycle Bells	.50

Agents Wanted.

Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.

Ohio Electric Works,
15 S. Water St.,
Cleveland, Ohio.

"H" BELL
EASY RINGER.
PIVOTED ARMATURE,
DOUBLE ADJUSTMENT.
SEND FOR CATALOGUE.
HUEBEL & MANGER,
MANUFACTURERS,
290 Graham St., Brooklyn, N. Y.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
PITTSBURG, PA.

New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

The Tuerk Alternating Current Ceiling Fan.

1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.

THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,
FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

The Best of Incandescent Lamps for 12 cents each.

Send us your burned-out lamps and we will return them at the above price and GUARANTEE them to be equal to the best.

We have a good filament. We procure a vacuum superior to the mercury process.

We renew only those bulbs which have not lost their vacuum, and thus proven that they are without flaw.

We thoroughly clean the bulbs and tighten the loose collars.

Lamps to be renewed should be sent by FREIGHT, as we pay charges to our factory. Be sure your name accompanies shipments and advise us by letter of voltage, base, efficiency and candle power desired.

Lynn Incandescent Lamp Co., Lynn, Mass.

BUCKEYE

QUALITY UNEQUALED
FACTORY PRODUCTION TRIPLED.

INCANDESCENT LAMPS.

Monadnock Building, Chicago. **THE BUCKEYE ELECTRIC CO., Cleveland, Ohio.**

FIVE GOOD BOOKS.

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICIAN PUBLISHING CO., Suite 510 Marquette Building, CHICAGO, ILL.

ONE DOLLAR EACH.

SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA,

——MANUFACTURERS OF——

Direct Current, Multipolar, Slow Speed, External Armature Generators and Motors, especially adapted for Direct Connection.
(Type I)—In sizes from 20 to 2,000 H. P.
Direct Current, Multipolar, Medium Speed, Internal Armature Generators and Motors adapted for Belting.
(Type A.)—In sizes from 10 to 300 H. P.
Direct Current, Bipolar, Medium Speed, Internal Armature Generators and Motors adapted for Belting.
(Type L. H.)—In sizes from 5 to 130 H. P.
Direct Current Boosters, absolutely controlled by U. S. Patents granted to Siemens & Halske Electric Company.

SIEMENS' BAND ARC LAMPS FOR DIRECT AND ALTERNATING CURRENT, ELECTRIC MINING LOCOMOTIVES, STEAM LOCOMOTIVES, ETC., ETC.

COMPLETE ELECTRIC RAILWAY EQUIPMENTS UNDER SIEMENS' PATENTS:

Siemens' Underrunning Trolleys.

The Siemens Contact Bar is safer than the ordinary trolley, and the overhead construction is less costly. Dr. Ernst Werner von Siemens was the pioneer in Electric Traction. He built his first Electric Railway in 1879. Write for Catalogues and further information to

SIEMENS & HALSKE ELECTRIC CO. OF AMERICA, 98 Jackson St., Chicago.

SALES OFFICES:—NEW YORK, Eastern District, American Surety Building; GREATER NEW YORK, 136 Liberty St. CINCINNATI, Perin Building. MINNEAPOLIS, 249 Second Avenue, South. DENVER, 608 Boston Block. SALT LAKE CITY, Knutsford Hotel Building. SAN FRANCISCO, 10 Front St. BOSTON, John Hancock Bldg. PHILADELPHIA; 531 Chestnut St.

NOTICE.

The General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company, and the Tesla Electric Company have brought suits against the Scott & Janney Electric and Manufacturing Company of Philadelphia for "alleged infringements" of their various patents.

This is the usual "bluff" that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such inventions.

We are manufacturing under our own patents and are not infringing. The above named firms are suing us on a fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. And it works. They will try by strategy to do what they dare not do openly.

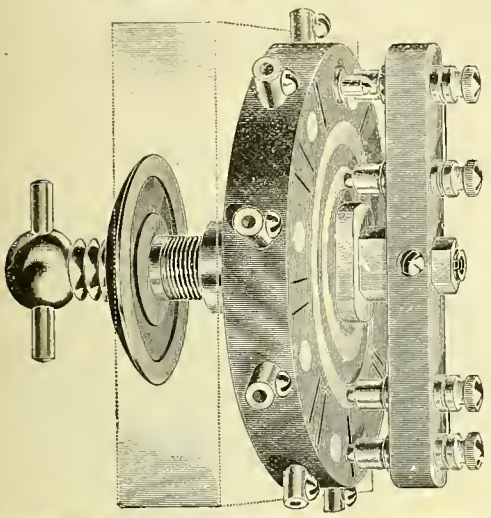
We wish to ask that the dealers and others that have received, or will receive, threatening letters from the above named concerns, will please send the same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated.

The Scott & Janney Long Distance Single-Phase Alternating Railway and Power System will supersede the inventions of the above named companies, and they know it.

Scott & Janney Electric and Manufacturing Co., 1707-9 Filbert Street, Philadelphia, Pa.

HARRY S. SMITH, Philadelphia, Pa., General Agent for Pennsylvania, New York and New England.



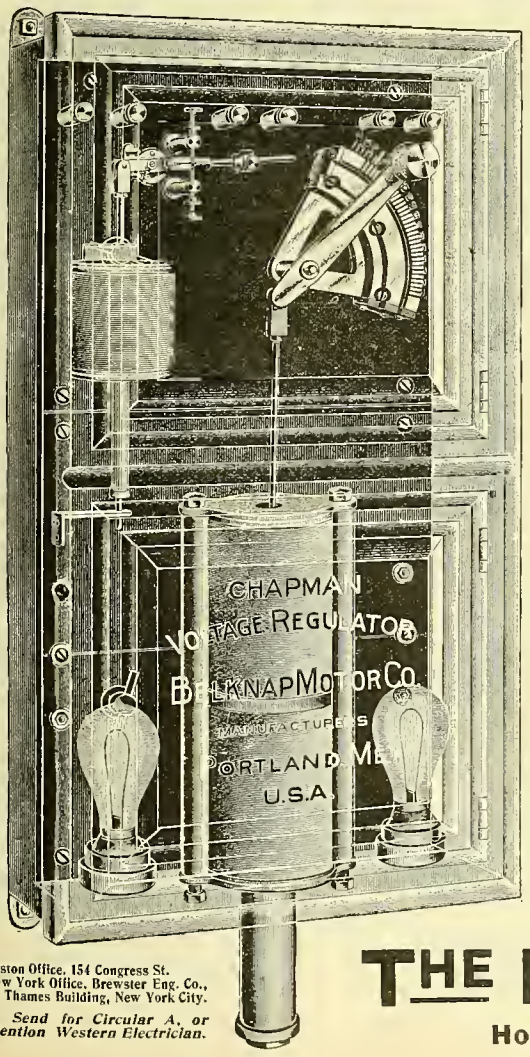
VOLTMETER SWITCHES.

The working parts of this switch are mounted on a fibre disk arranged in such manner that there is no possibility of reversing the current through the voltmeter. Can be used as a ground detector switch. Very neat and pretty in design and can be made highly ornamental.

MANUFACTURED BY

Electric Engineering & Supply Co.,

27 Thames St., New York. Syracuse, N. Y.



Steady Lights from Unsteady Power.

The Chapman Voltage Regulator

Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

Perfect regulation of voltage by an automatic device magnetically controlled. 25 to 50 per cent. variation in speed of water wheel or engine controlled within 2 per cent. of the normal, and it acts as quick as a circuit breaker. Every central station should have them. Generators can be worked nearer the limit of their capacity by their use, thus increasing their effective working power.

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Vermont Electric Light Co., Burlington, Vt.
Glen Mfg. Co., Berlin, N. H.
Rumford Falls Sulphite Co., Rumford Falls, Me.
Northfield Electric Co., Northfield, Vt.
Hollingsworth & Whitney Co., Waterville, Me.
Bar Mills Electric Co., Bar Mills, Me.
Forest Mills Co., Bridgton, Me.
Norway Electric Light Co., Norway, Me.
Crookston Water, Pr. & Lt. Co., Crookston, Minn.
Pondicherry Mills, Bridgton, Me.
Kingston Electric Co., Philadelphia, Pa.
Burgess Sulphite Co., Berlin, N. H.
Cliff Paper Co., Niagara Falls, N. Y.
Westbrook Electric Light Co., Westbrook, Me.
Valleyfield Electric Co., Valleyfield, Quebec.
Orr & Co., Paper Mills, Troy, N. Y.

Recent orders have just been received from Stanley Electric Mfg. Co., Pittsfield, Mass.; Calumet & Hecla Smelting Co., So. Lake Linden, Mich.; Edison Elec. Ill'g Co., Topeka, Kan.; Marietta Elec. Co., Marietta, O., and Westbrook Elec. Lt. & Pr. Co., Westbrook, Me.

CORRESPONDENCE SOLICITED.

Patents owned and controlled exclusively by

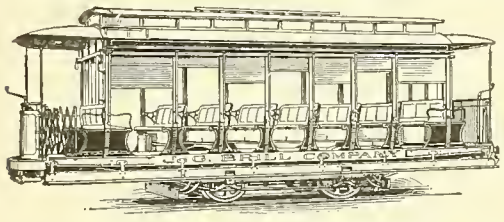
THE BELKNAP MOTOR CO.,

Home Office and Manufactory: Portland, Me., U. S. A.

Boston Office, 154 Congress St.
New York Office, Brewster Eng. Co., Thames Building, New York City.

Send for Circular A, or mention Western Electrician.

J. G. BRILL COMPANY, PHILADELPHIA,



MANUFACTURERS OF
Electric Cars and Trucks,
Solid Forged Frame Trucks,
Trucks for 4-Wheel Cars.

PIVOTAL TRUCKS FOR STEAM AND ELECTRIC SERVICE.

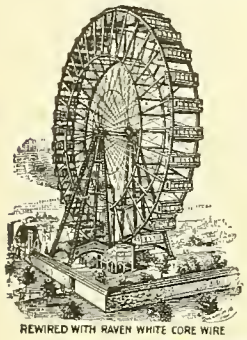
The PERFECT TRUCK, our "No. 27," is safer, easier on rails, easier for passengers and imparts less motion to the car body than any truck ever made.

WE CAN SUBSTANTIATE OUR CLAIMS.

ELECTRIC HEATING APPARATUS!
SPECIALTY—SOLDERING IRONS.
AMERICAN ELECT'L HEATER Co
DETROIT, MICH.

Fort Wayne Electric Corporation,
FORT WAYNE, IND.

Apparatus for
Arc, Direct Current and Alternating Incandescent Lighting and Power Transmission.



REWIRED WITH RAVEN WHITE CORE WIRE

—OFFICE—
The Ferris Wheel Co.
1131 THE ROOKERY.

CHICAGO, April 30, 1896.

NEW YORK INSULATED WIRE CO.,
320 Dearborn St., Chicago, Ill.

GENTLEMEN:—After carefully considering the merits of the various brands of wire upon the market, we have decided to use your "Raven White Core" exclusively for rewiring the Ferris Wheel.

As you are aware, the wire upon the wheel is very much exposed and the test will no doubt be a most severe one.

Yours very truly
THE FERRIS WHEEL CO.
By L. V. Rice, Mgr.

GRIMSHAW WHITE CORE. Used exclusively for all Incandescent Lighting at World's Columbian Exposition.
RAVEN WHITE CORE. Used in some of the largest buildings in the United States.
COMPETITION LINE WIRE. Used by some of the largest Central Stations and Fire and Police Departments in the U. S.
GRIMSHAW TAPES, COMPETITION TAPES AND SPLICING COMPOUNDS.

New York Insulated Wire Company,

MAIN OFFICE: 13-17 Cortlandt St., New York.
BRANCHES: CHICAGO: 320 Dearborn St. BOSTON: 134 Congress St. SAN FRANCISCO. 115 New Montgomery St.

THE MAGNIFICENT CONVENTION

NUMBERS OF THE WESTERN ELECTRICIAN WILL SURPRISE YOU. NOTHING LIKE THEM HAS EVER BEEN SEEN IN ELECTRICAL JOURNALISM. WE SHALL SURPASS OUR LAST YEAR'S RECORD AND YOU KNOW WHAT THAT WAS.

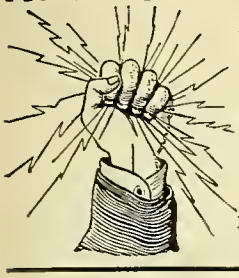
PERHAPS YOU HAVE ALREADY ARRANGED FOR ADVERTISING IN THESE NUMBERS. IF SO, YOU HAVE EXERCISED GOOD BUSINESS JUDGMENT. IF NOT, THERE IS YET TIME TO SECURE SPACE.

YOUR ADVERTISEMENT SHOULD REACH US BY JUNE 5TH. BETTER SEND IT BY FIRST MAIL.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.
CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE "CLARK" WIRE.

FOR SWITCHBOARD, RAILWAY and MOTOR USE.

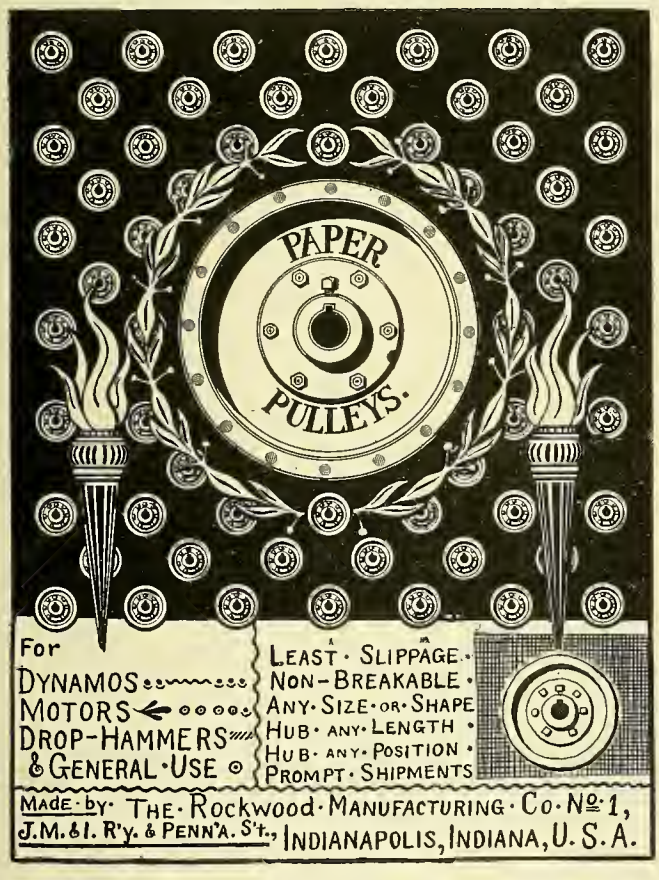
All sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

Inspector Boston Fire Underwriters' Union says:
"A thoroughly reliable and desirable wire in every respect."

The Clark wire has been before the public and in use for the past ten years, and has met with universal favor. We guarantee our insulation wherever used. Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treas. and Gen'l Manager.
HERBERT H. EUSTIS, Pres. and Electrician.
61-63 Hampshire Street, BOSTON, MASS.



NEW EDITION,
CROSBY & BELL'S ELECTRIC RAILWAY,
JUST OUT. PRICE $2.50. SEND FOR IT.
ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO.

EVERYTHING IN WIRE.

BARE AND INSULATED.

ALSO MANUFACTURERS OF THE "CHICAGO" RAIL BOND.

WASHBURN & MOEN MFG. CO.,

WORCESTER, MASS.

BRANCH OFFICES AND WAREHOUSES: New York, Chicago, San Francisco, Houston, Philadelphia, Pittsburg, Scranton.

Patented.

No. 11 DOUBLE GROOVE PONY INSULATOR

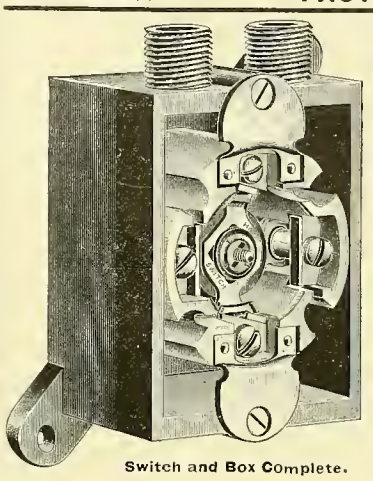
HIGH INSULATION.

The most perfect Glass Insulator made is the Teat Insulator.

"The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the Insulator into drops. The water drops from these points onto the cross arm, thereby preventing the moisture from creeping to the pin."

HEMINGRAY GLASS CO., Covington, Ky.

FACTORIES, MUNCIE, IND.



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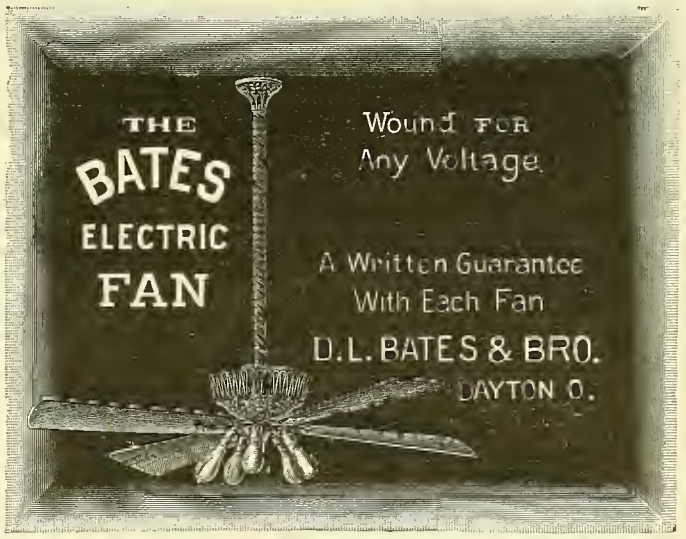

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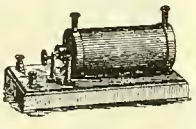

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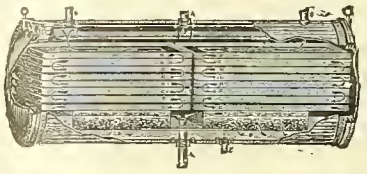

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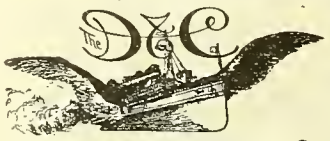

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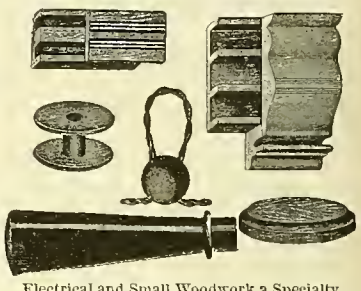

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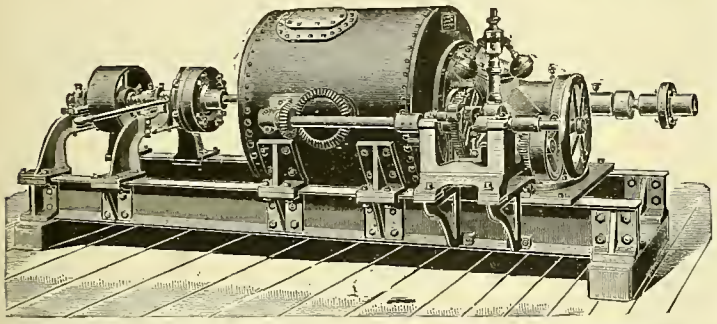

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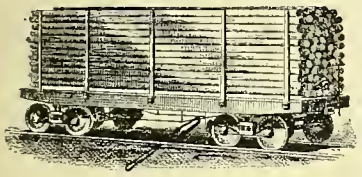

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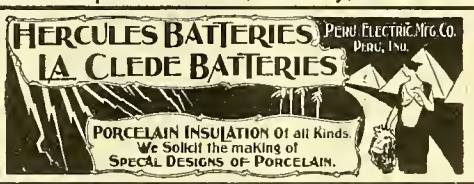

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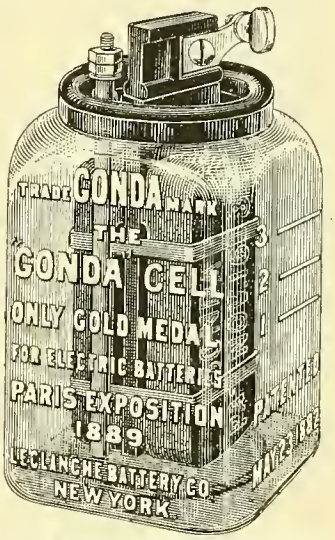

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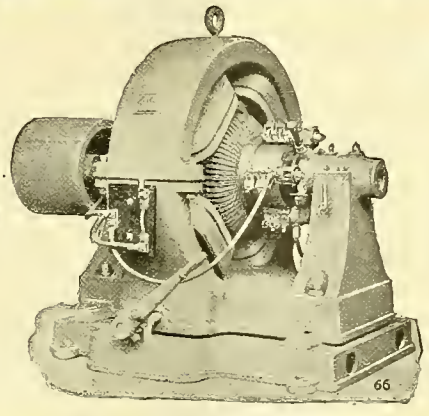

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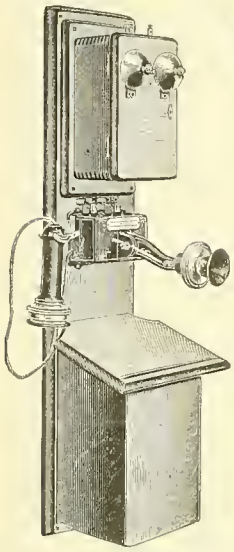

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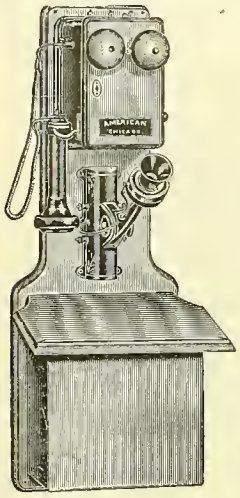

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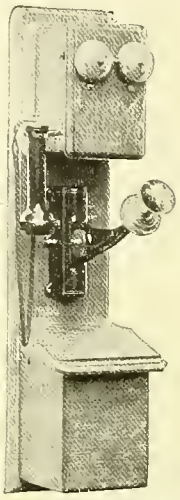

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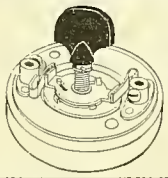

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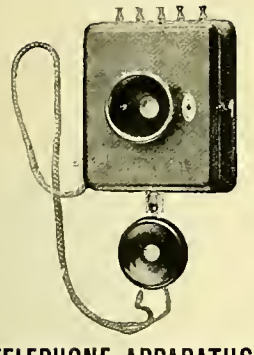

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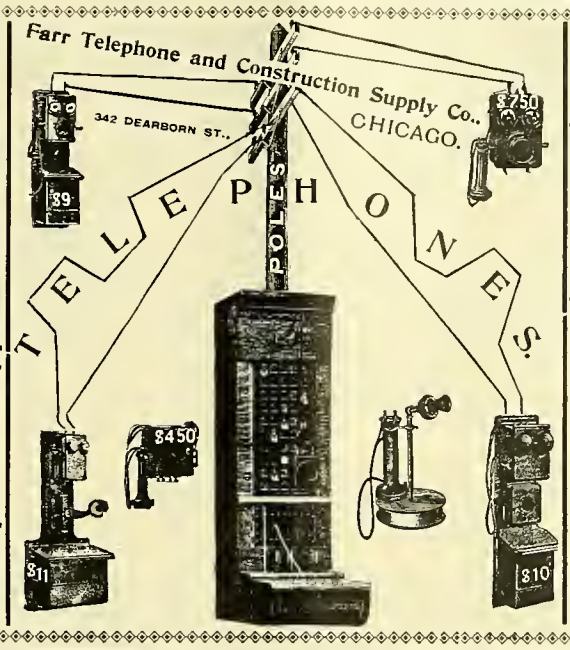

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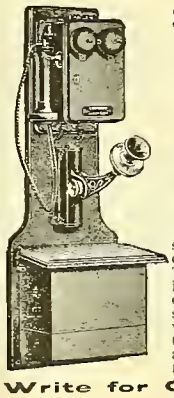

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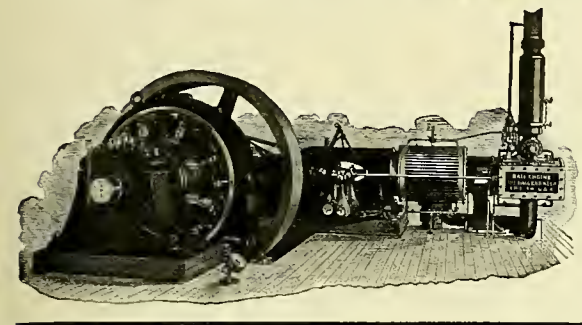

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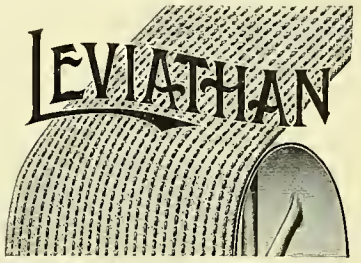

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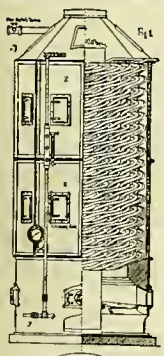

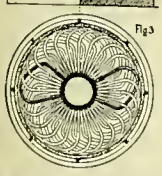

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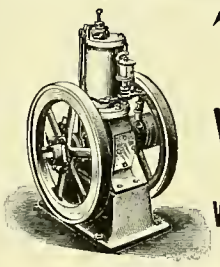

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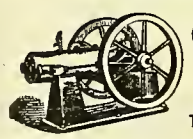

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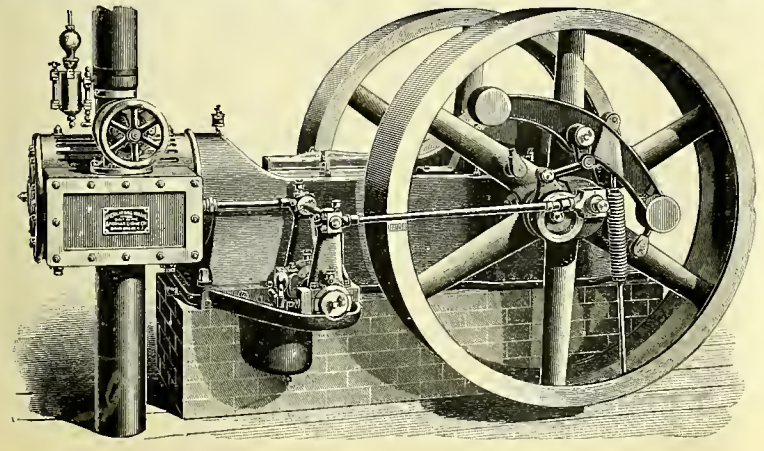

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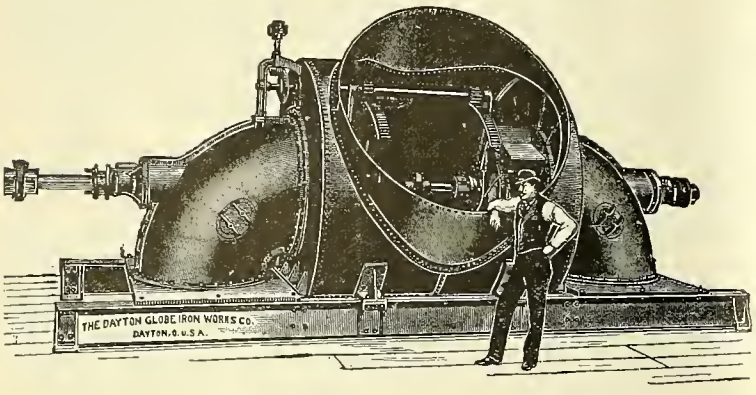

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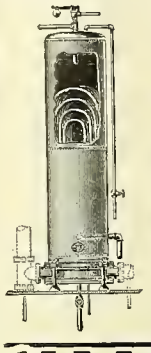

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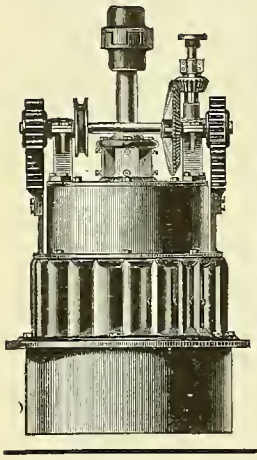

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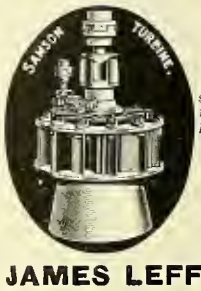

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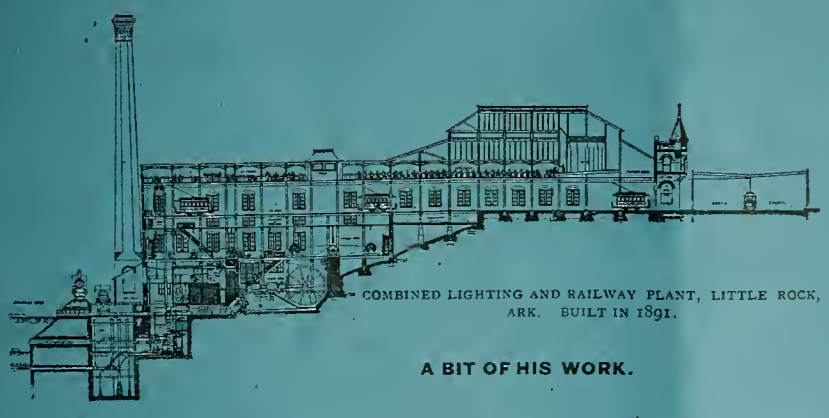

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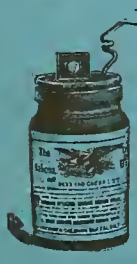

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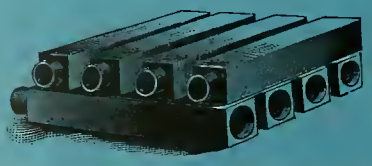

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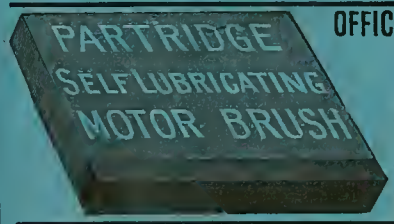

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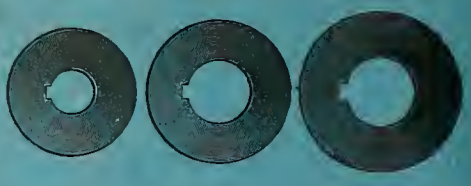

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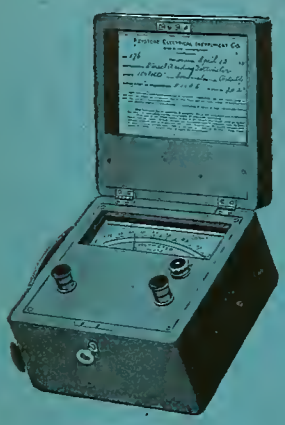

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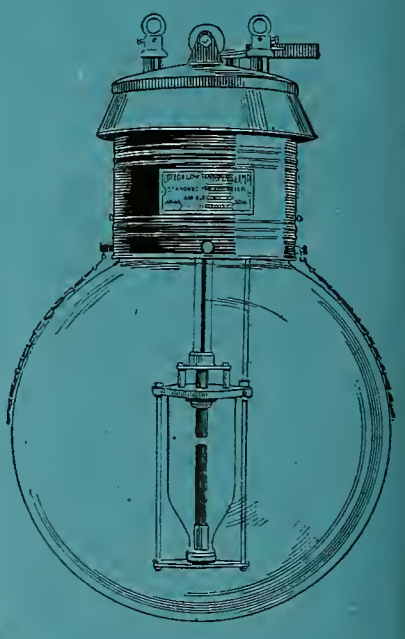

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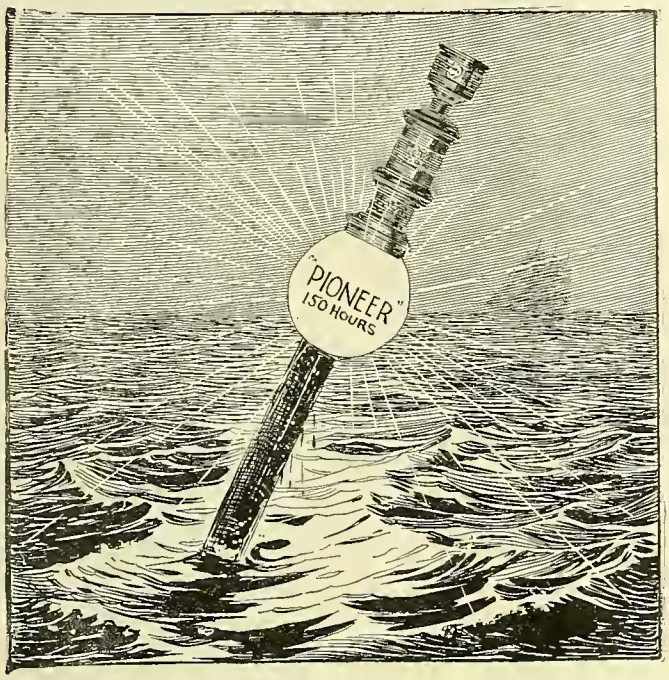

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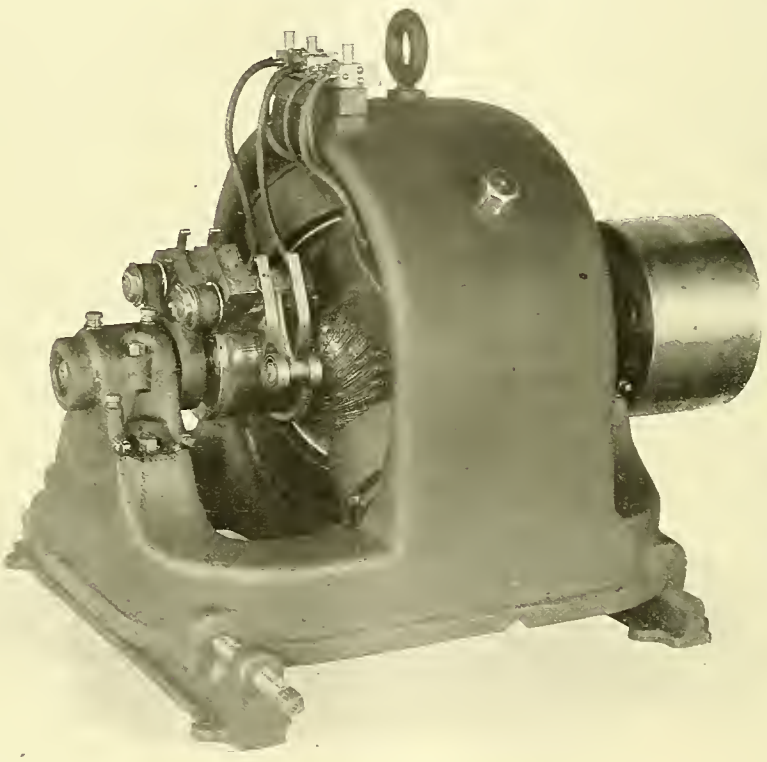

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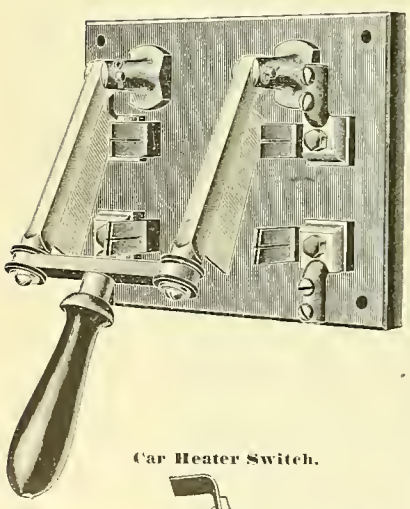
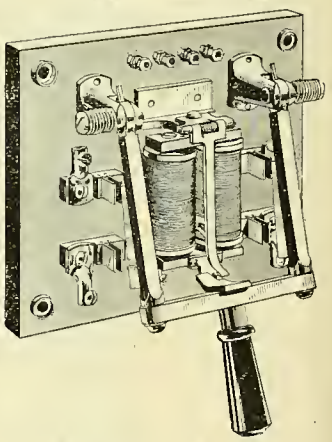


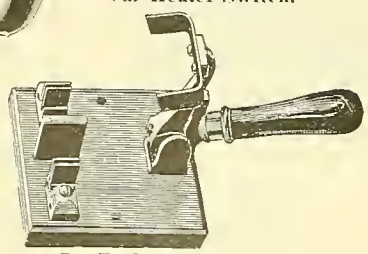
Switches for High and Low Voltage.

Burglar Alarm Switch.

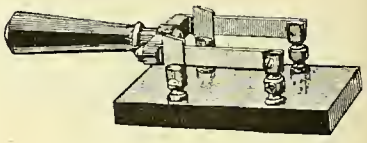


Station Switches--Jack Knife.
Motor Switches--Style A.
Motor Switches--Style B.
Burglar Alarm--J. K. S.
Car Heater Switch.
Lyon Brake Handle.

Car Heater Switch.



Style B Switch.



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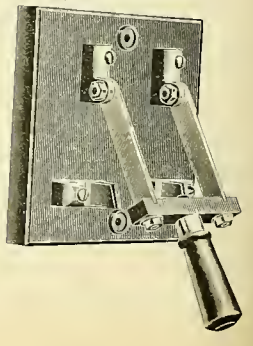
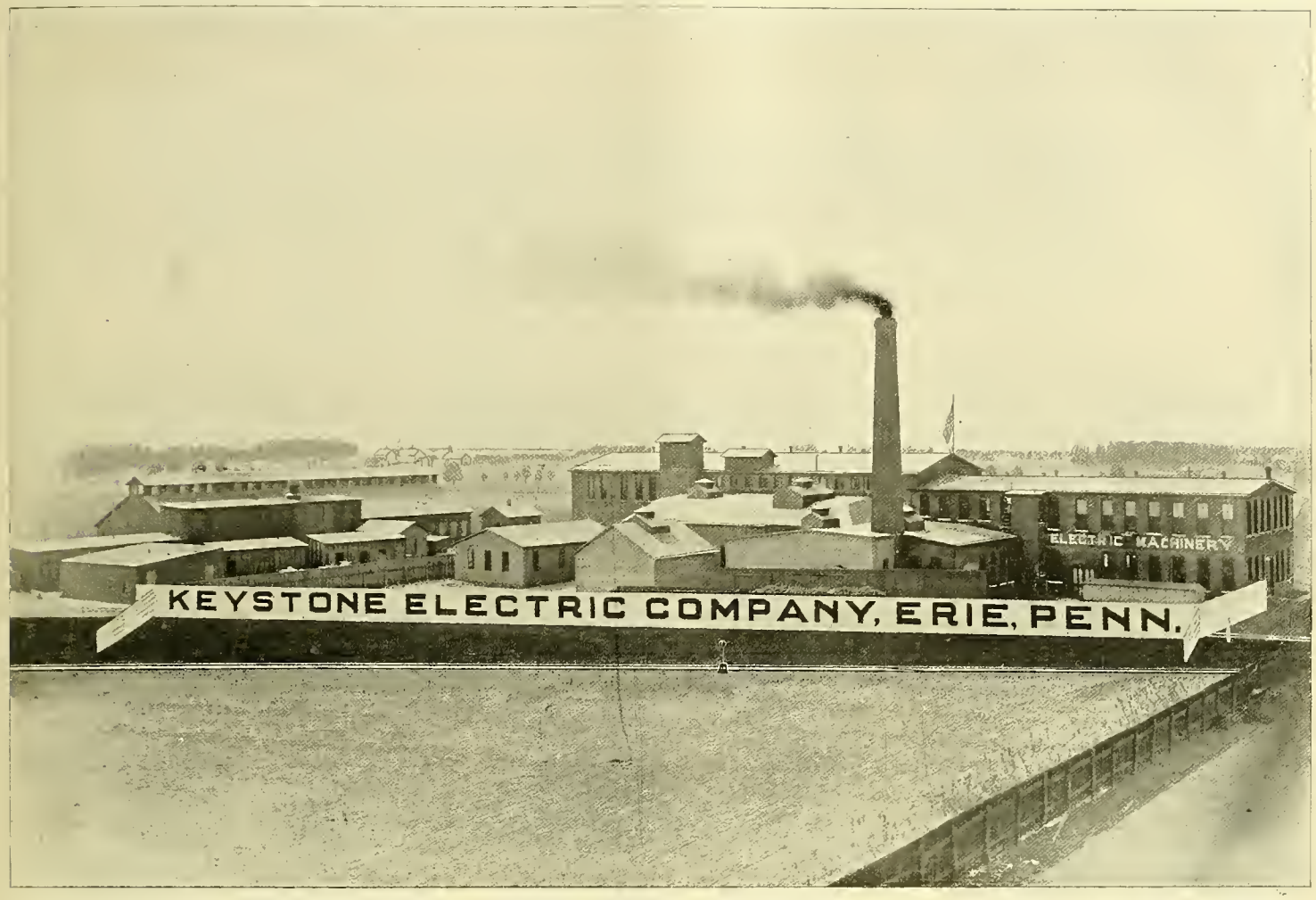
Style A Switch.



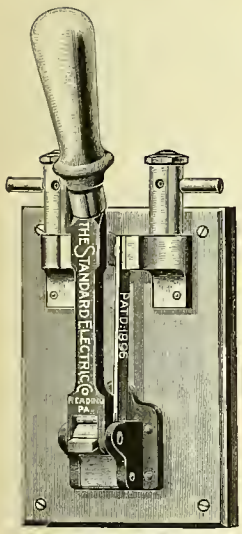
Fisher & Cramphorn,

Office and Factory, Corner Congress and A Streets, BOSTON.



There are QUICK BREAK and Quick Brake

SWITCHES.



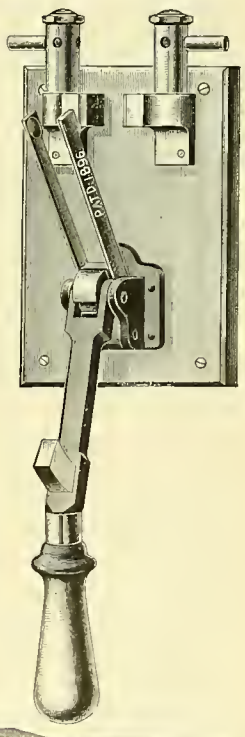
We do not hesitate to say that the Engineering conditions which

"The Standard" Switch

Offers, its remarkably QUICK BREAK, will make it

The MODERN SWITCH for all ELECTRICAL WORK

To be Done in the Future by ELECTRICIANS.



Stock sizes carried from 15 to 500 amperes, all guaranteed on 500 volt circuits.

Single, Double and Triple Pole and Double Throw.

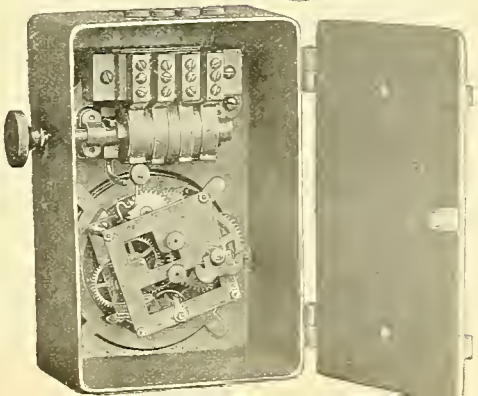
CORRESPONDENCE SOLICITED.

The Standard Automatic Time Cut-Out

May be set to open circuit at any time of day or night.

ENTIRELY AUTOMATIC.

Approved by Fire Underwriters.



The Standard Electric Co.,

READING, Pa., U.S.A.

TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

By the use of **Chloride Accumulators** electric lights and electric elevators can be operated from one dynamo, which is run under a full steady load, equal to the average demand, as against two or more dynamos operated under fluctuating loads with low load factors.

THE ELECTRIC STORAGE BATTERY CO.,
DREXEL BUILDING, PHILADELPHIA, PA.

BRANCH OFFICES: 20-22 Broad St., New York; 1543 Marquette Bldg., Chicago; 215 N. Calvert Street, Baltimore, Md.; 222 Market Street, San Francisco, Cal.; 92 State St., Boston, Mass.

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N. Y. Accumulator & El. Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

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Puritan Electric Co.
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Leclanche Battery Co., The.
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Huebel & Manger.
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Hodge, Walsh & Loring.
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Peoples Electric Co.
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Siemens & Halske Elec. Co.
Triumph Electric Co.
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Electric Appliance Co.
General Electric Co.
Metropolitan Electric Co.
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Phillips Insulated Wire Co.
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Muir & Son, Thos.
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Chicago Edison Co.
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Electric Appliance Co.
Elec. Eng. & Supply Co.
Empire China Works.
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Hodge, Walsh & Loring.
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Locke, Fred. M.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
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Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
Morse, S. F. B. & Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
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Boston Motor Co.
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Bullock Elec. Mfg. Co.
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Crocker-Wheeler El. Co.
Dallett & Co., Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
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General Electric Co.
Keystone Electric Co.
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
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Garlock Packing Co.
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Johns, H. W. Mfg. Co.
Standard Paint Co.

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Chicago Armature Co.
Chicago Edison Co.
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Electric Appliance Co.
Metropolitan Electric Co.
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Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Vaile

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Besly & Co., Chas. H.
Brixey, W. R.
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WOUND FOR ALL CURRENTS,
EXCEPT ALTERNATING.

New Designs for this Season.

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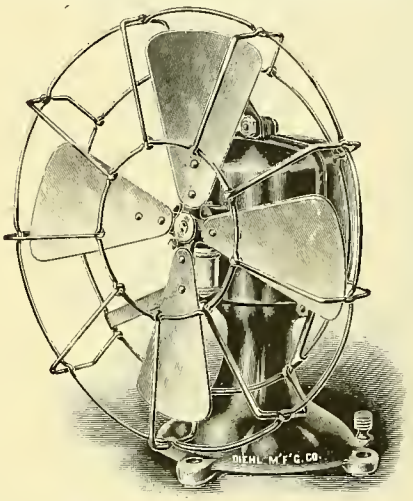
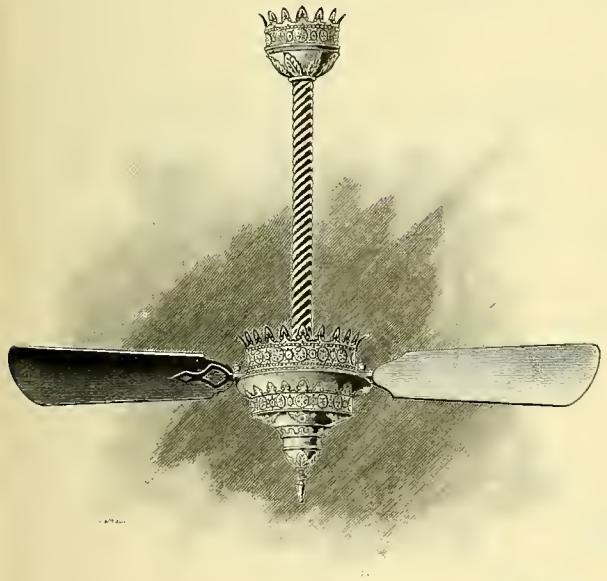
Column Fans,
Propeller Fans,
Exhaust Fans.





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GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

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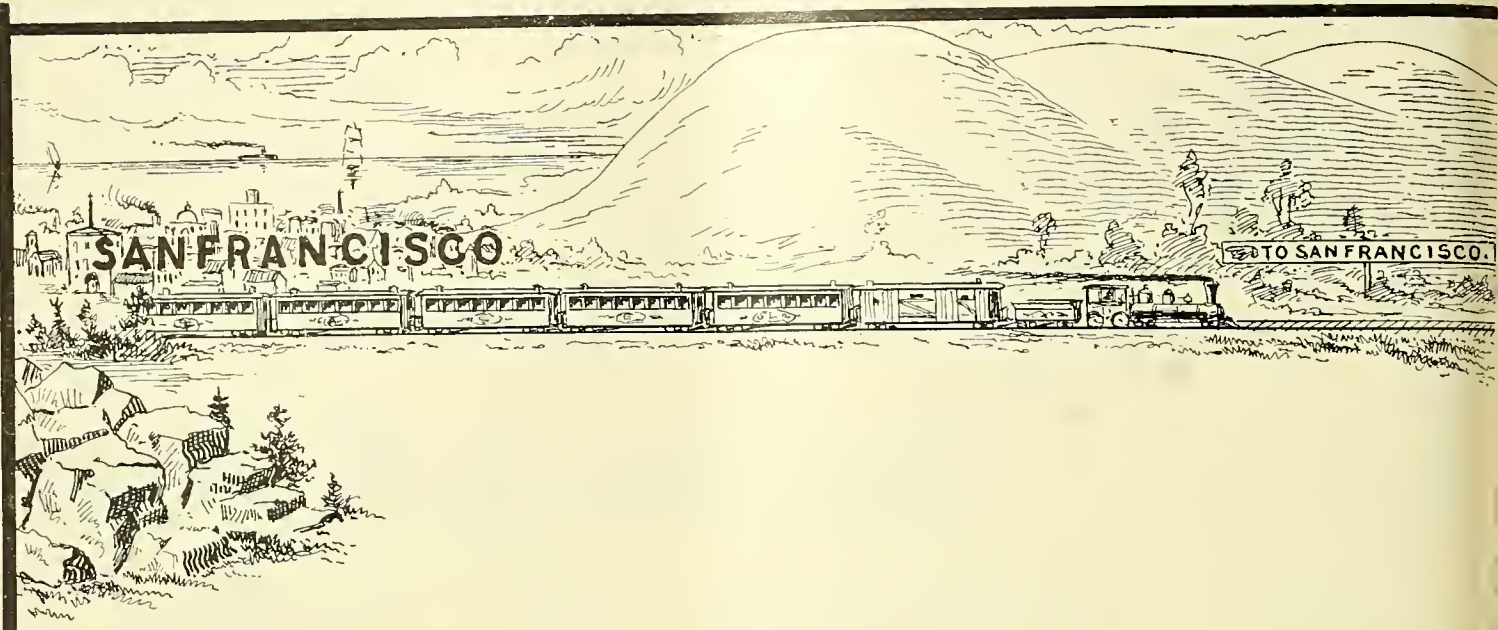
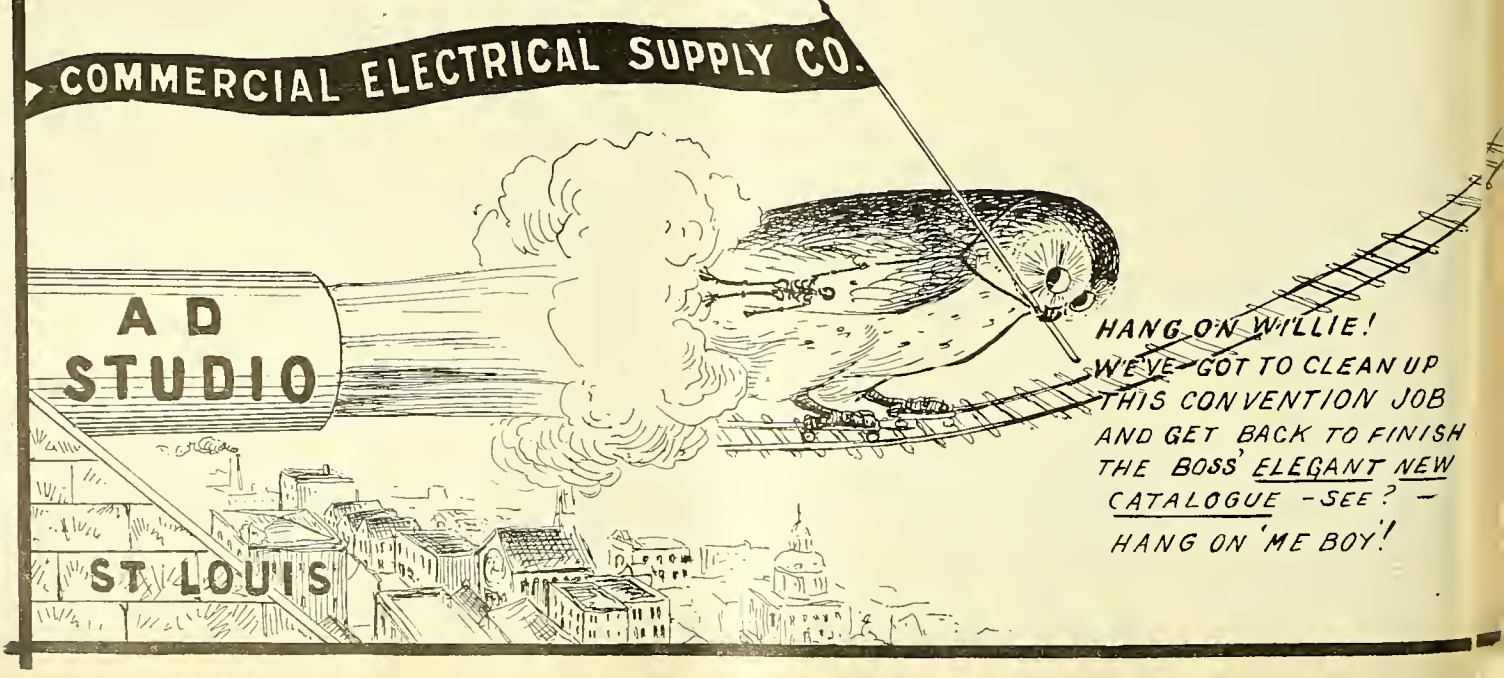
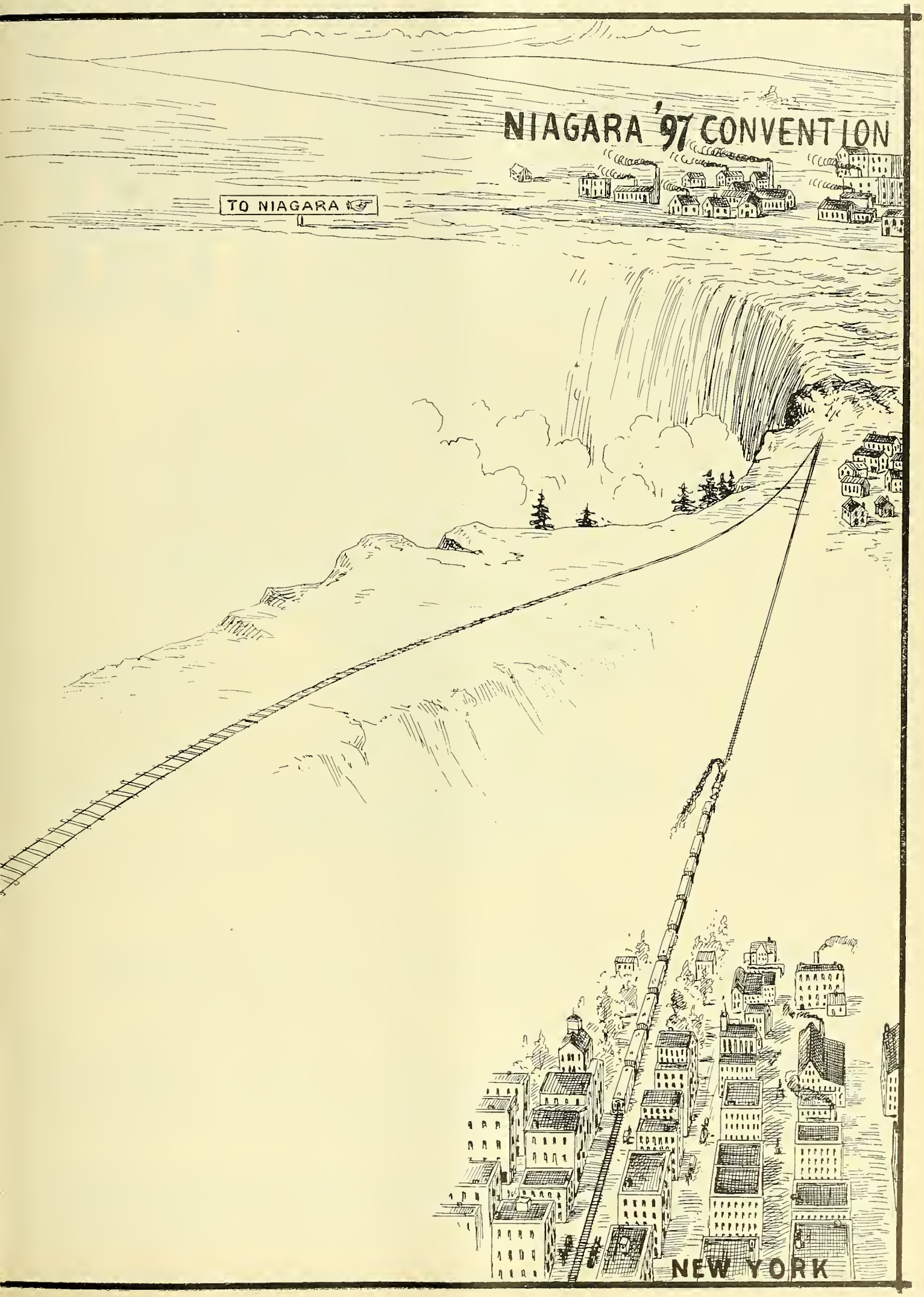
Diehl Manufacturing Company

Elizabethport, N. J.



WE'LL BE THERE!

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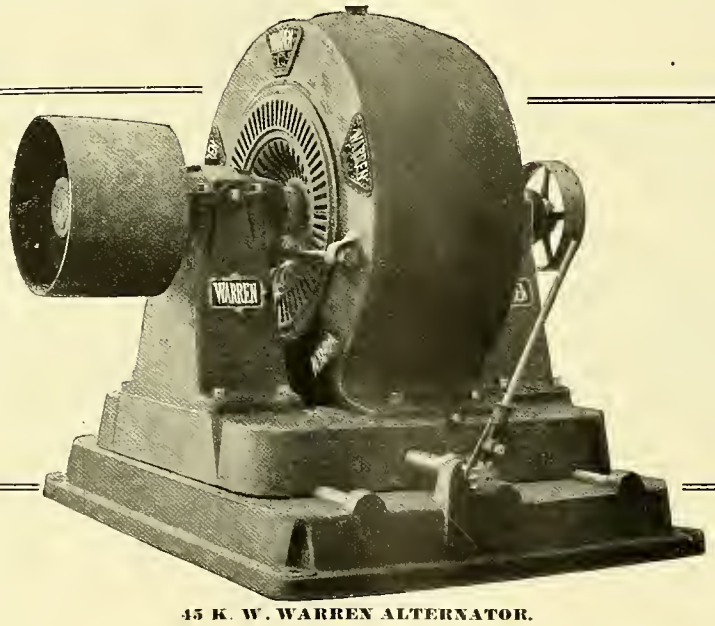
TO NIAGARA
NEW YORK

THE WARREN ALTERNATOR.

THE MODERN DYNAMO FOR CENTRAL STATION WORK

Highest Efficiency.

Closest Regulation.



45 K. W. WARREN ALTERNATOR.

Aside from necessary lubrication, it requires absolutely no attention under most severe service.

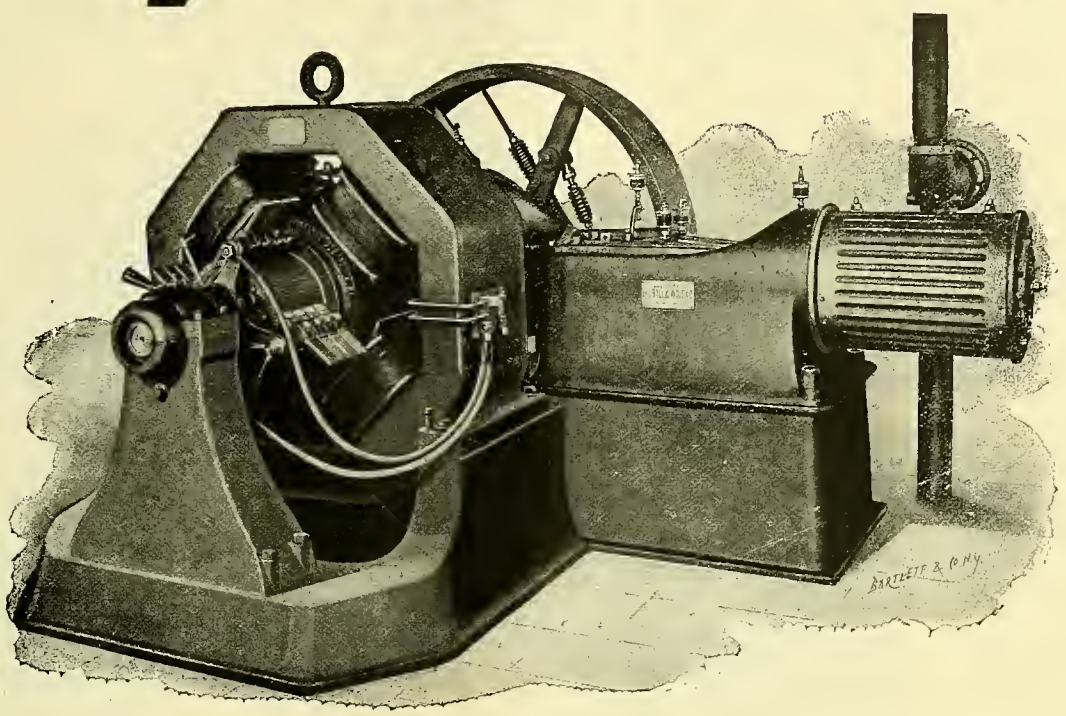
Induction Type.
Any Voltage or Multi-Voltage.
Stationary Armature. Stationary Field.
No Moving Wire. No Brushes.
Moderate Speed. Non-Hazardous.

WRITE TO

Warren Electric Manufacturing Co.,

Sandusky, Ohio.

Eddy Generators



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We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

All Our Apparatus Guaranteed as Represented.

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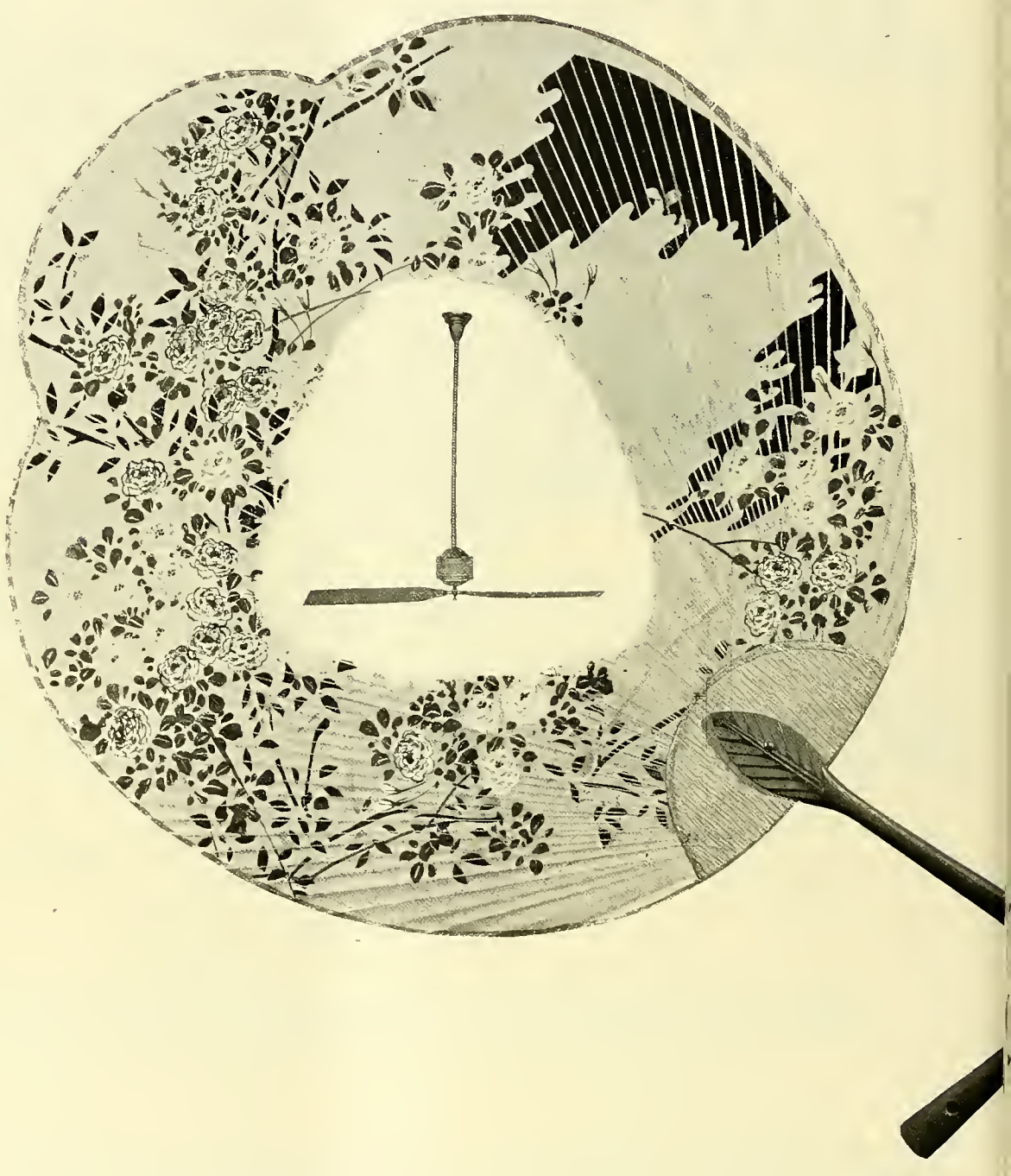
Boston, G. M. Angier & Co., 64 Federal St.
San Francisco, Cal., California Electrical Works, 409 Market St.
Elmira, S. N. Blake.
St. Louis Western Electrical Supply Co.
Kansas City, W. T. Osborn.
Cincinnati, O., John A. Stewart.

Western Office: 204 Dearborn St., Chicago, Wallace & Hine, Western Agents.

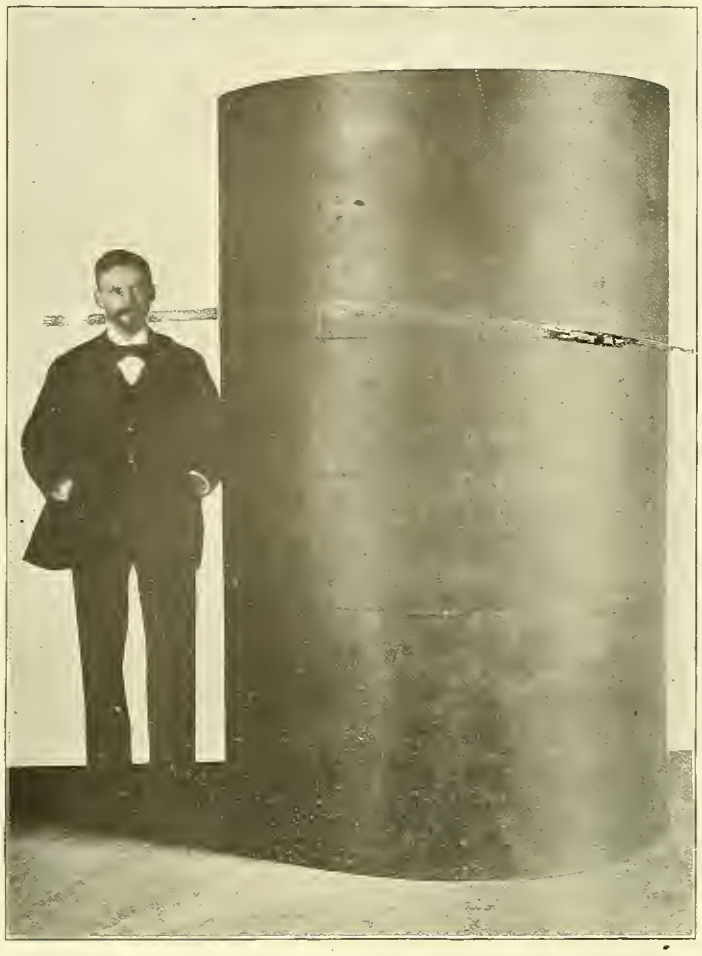
The Most Ancient and the Most Modern.



New York.

Western Electric Co.,

Chicago.



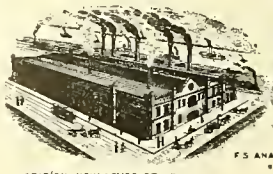
Largest Leather Belt in the World.

MANUFACTURED BY

CHICAGO BELTING COMPANY,

67-69 South Canal Street, CHICAGO, ILL.

GEO. Q. WHITNEY & A. S. BADGER, RECEIVERS



LOUISIANA ELECTRIC LIGHT CO.

ARC AND INCANDESCENT ELECTRIC LIGHTING & POWER

F. S. ANABLE, GENERAL MANAGER

STATION NEW LEVEE ST. BET. RICHARD & MARKET STS.

OFFICE OF RECEIVERS 826 GRAVIER, ST. TELEPHONE No. 1486

NEW ORLEANS, LA. Dec. 16th, 1896.

Chicago Belting Co.,
316 & 318 St. Charles St.

Gentlemen:-

In reply to your enquiry regarding the 143 feet of 84 inch wide three ply "Reliance Belt", furnished to us by your Company, we wish to say that it has now been in use for about five months. We have found that this belt is all that you claimed it to be, and since the day it was put on the pulleys, it has never given us a moment's trouble. It runs true and straight, is very even, and has stretched very little, although we have carried with it a load of 1800 horse power. The belt is made without rivets or pegs, depending only on the cement, none of the laps or joints have opened, and the belt is in apparently as good condition as it was the day it was placed upon the pulleys.

Very truly,

Supt.

WRITE FOR PRICES ON "DYNAMO" BELTING.

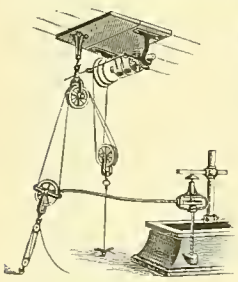
ESTABLISHED 1875.

STOW MFG. CO., Binghamton, N. Y.

Inventors. Oldest and Largest Manufacturers in the World of the

Stow Flexible Shaft

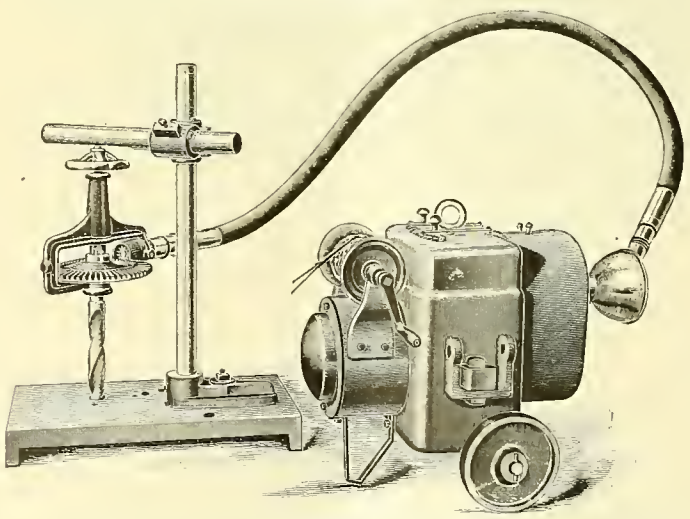
FOR ALL PURPOSES.

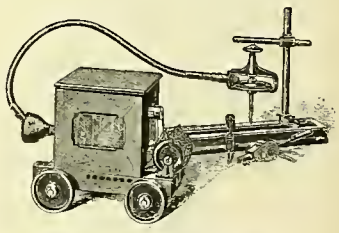


Drilling Plant—
Rope Transmission.

Where an electric current is not accessible, use the Flexible Shaft driven by rope transmission.

Thousands of them in use.





Overtype (Wood Truck) Combination.

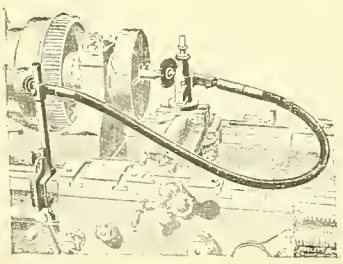
The Combination of Flexible Shaft and Overtype Motor has been on the market for the past four or five years.

It is strongly built and as well protected as any of its type.

It has done excellent service.

The Center Grinder

Is as durable and more quickly adjusted than any similar tool on the market.



Center Grinder.

COMBINATION OF

Stow Flexible Shaft and Iron-Clad Electric Motor

FOR PORTABLE DRILLING, TAPPING, REAMING, EMERY GRINDING, ETC.

The Motor is practically dust and water proof, very simple and efficient and will withstand an unusual amount of hard usage.

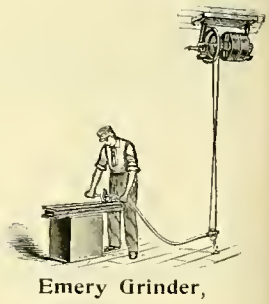
Catalogue and Price List Furnished on Application.

General European Agents:

SELIG SONNENTHAL & CO., 85 Queen Victoria Street, LONDON, ENGLAND.

The Portable Emery Grinder

Is one of the best selling and useful appliances on the list. None are giving more general satisfaction.



Emery Grinder, Portable.

DIVIDENDS FOR CENTRAL STATION MEN.

By saving your burned out lamps and sending them to us for renewal we can save you 25 to 50 per cent. on your lamp bills. We return you first-class, guaranteed lamps for 12c. each.

If you have any doubts send us a trial order or for samples.

Can we fill your orders?

Just look at our new factory. Its workrooms have 30,000 feet of floor space equipped with machinery especially adapted to renewing lamps. Our process has every up-to-date feature.

We have a superior filament.

We procure a vacuum nearer perfect than is possible by the mercury process, as is proven by the fact that our lamps are cool to the hand (an infallible test).

We renew only those lamps which have not lost their vacuum and by so doing prevent renewing a lamp which has a faulty or leaky bulb. This fact alone places the life of the renewed lamp out of reach of any other lamp on the market.

Our most popular types are our low volt 5.4 watt, high volt $3\frac{1}{2}$ and 4 watt and our series burning railway lamp, which does not require the anchor.

We also wish to purchase for cash 500,000 more burned out lamps.

Send by freight at our expense and be sure your name accompanies shipment.

LYNN INCANDESCENT LAMP COMPANY,

LYNN, MASS.

SHELBY

The demand for the now famous Shelby Incan
overcrowded with orders during the past three mon
sufficient to fill these orders. We have, however, twice
orders promptly for

THE BEST LAM

Write for Prices.

SHELBY ELECTRIC CO., Shelby, O.

LAMPS!!

descent Lamp has been so great, and we have been so
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doubled the capacity of our factory and can now fill all

PS ON EARTH!!

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Jas. C. Wormley & Co., Marquette Building: CHICAGO AGENTS.
Paragon Arc Lamp Co., Boston: NEW ENGLAND AGENTS.
William Wilson, Box 77: MILWAUKEE AGENT.
Wardell Jukes: PHILADELPHIA AGENT.
R. Schmidt, 253 Broadway; NEW YORK AGENT.

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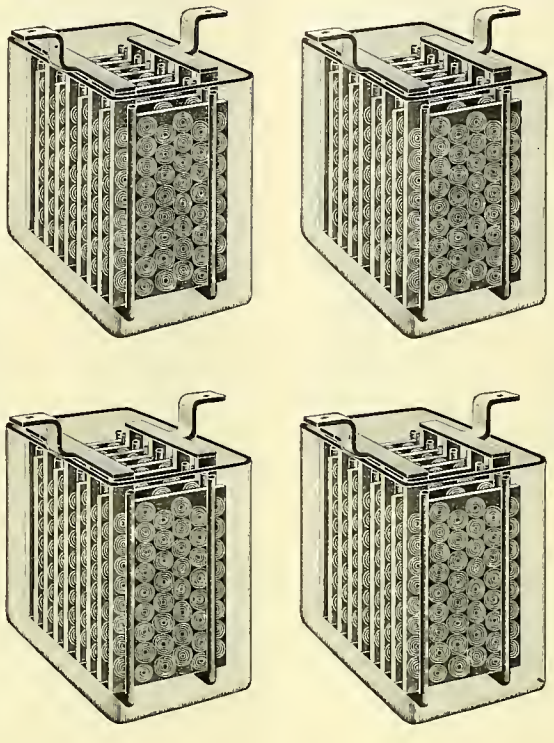
New Process, Perfect Insulation, Highest Efficiency.

Non-Infringing.



Protection Guaranteed.

An Electro-Chemically formed SOLID LEAD Plate. NO PASTE, NO PELLETS, NO CEMENT, NO JOINTS.

CANNOT BUCKLE NOR BEND. NO SHORT CIRCUITS IN CELLS. INTERNAL RESISTANCE VERY LOW.

Storage Batteries of any Capacity or Voltage

For Central Station Plants, Isolated Lighting Plants, Incandescent Lamp Testing, Trolley Regulating, Block Signal Service, Electroplating, Propelling Launches, Portable Tools, Ventilating Fans, Elevators, Horseless Vehicles, Telegraph and Telephone Stations, Phonographs, Chemical and Medical Use, X-Rays, Etc.

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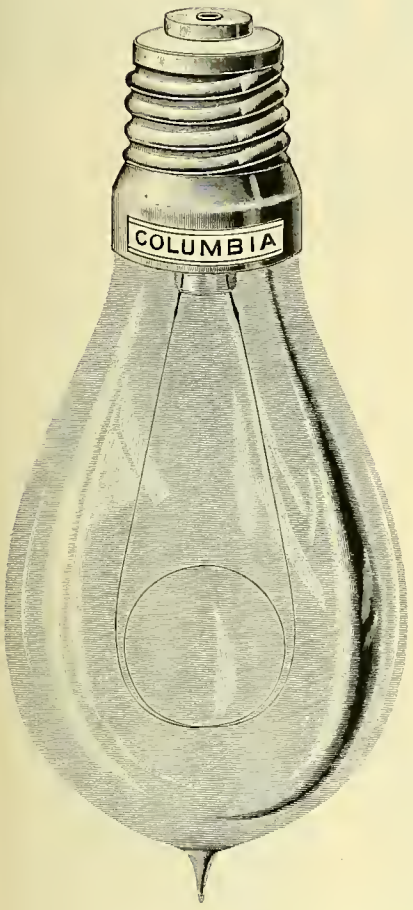
EASTERN OFFICE.
Machado & Roller, 203 Broadway.
New York.

Agencies in all Large Cities.
Write for Catalogue.

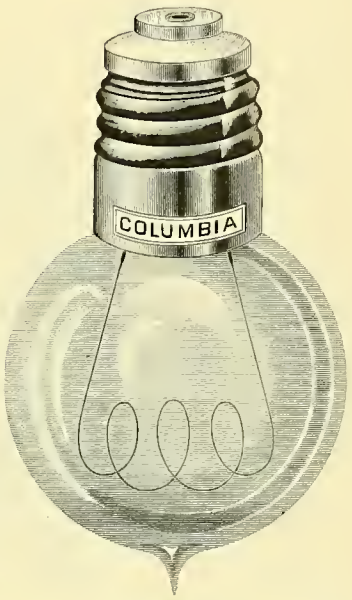
A. W. KILBOURNE,
GENERAL SALES AGENT.

COLUMBIA

Incandescent Lamps.



UNEQUALED IN QUALITY.



Before renewing your annual contracts for Incandescent Lamps we request you to make a test of the Columbia. We believe you will find it the most uniform in candle power and in consumption of energy. The candle power is well sustained and the lamps do not grow yellow with age. They furnish the most economical means of transforming electrical energy into light and large savings may be made by their adoption.

We request correspondence with those desiring lamps for immediate requirements or for future delivery. Special prices for annual requirements.

Lamps carried in New York stock for the accommodation of our Eastern trade.

Our prices have never been lower than at present.

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BRANCH OFFICES:

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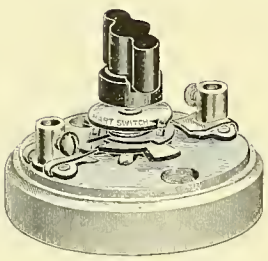

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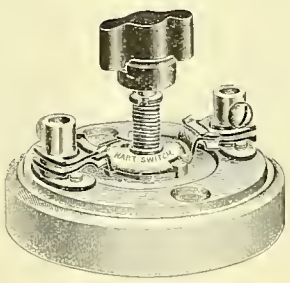

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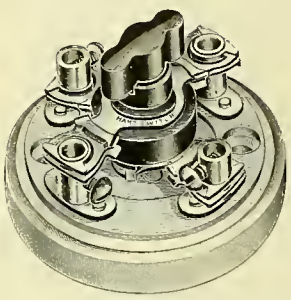

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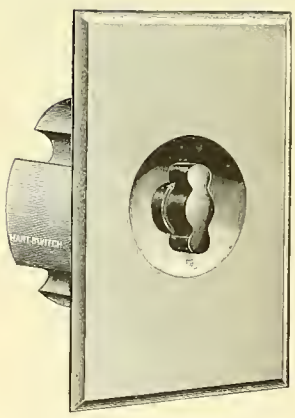
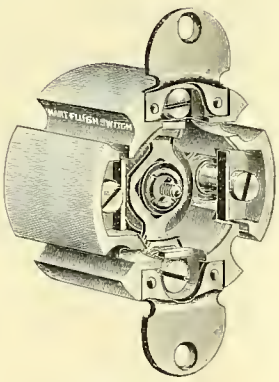


NO. 1 PLATE.



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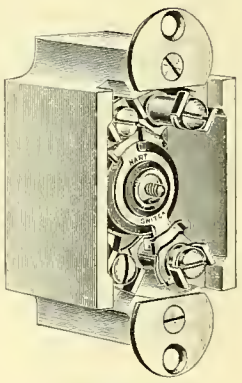

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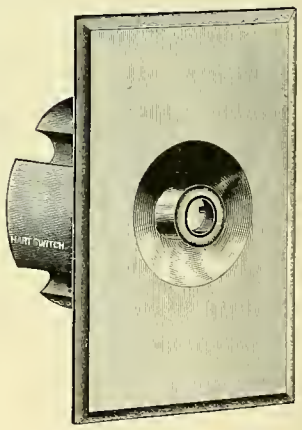

LOCK FLUSH.

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THE HART & HE

Hartford

witches!

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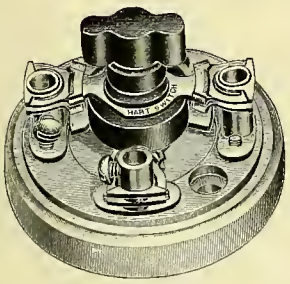

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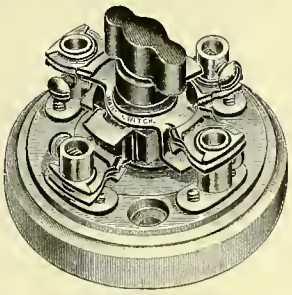

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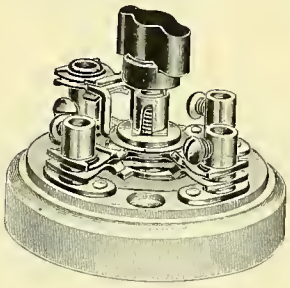

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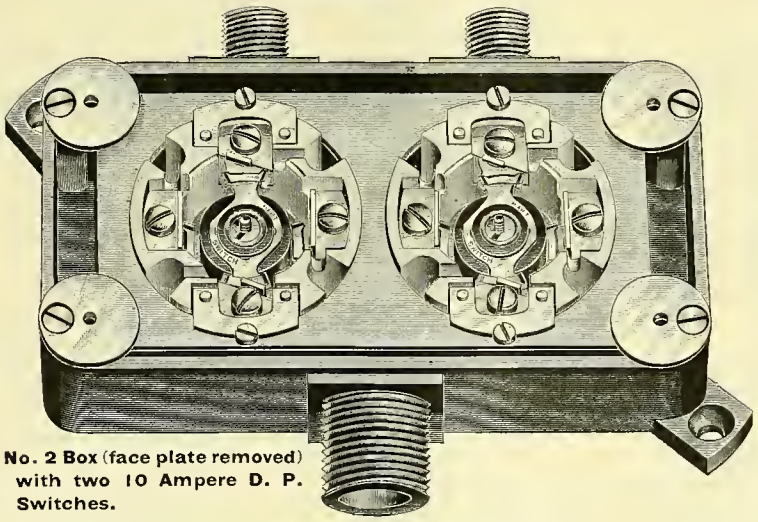


No. 2 Box (face plate removed) with two 10 Ampere D. P. Switches.

Metal of Every Genuine Hart Switch.

GEMAN MFG. CO.,

- Conn.

ALCATRAZ ELECTRICAL COMPOUND, INTERIOR CONDUIT TAPE.

MANUFACTURED BY

The California Asphalt Co.,

57 East 59th Street, New York.

Absolutely Unequaled for

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch Boards.

WATER-PROOFING CUT-OUT BOXES, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.

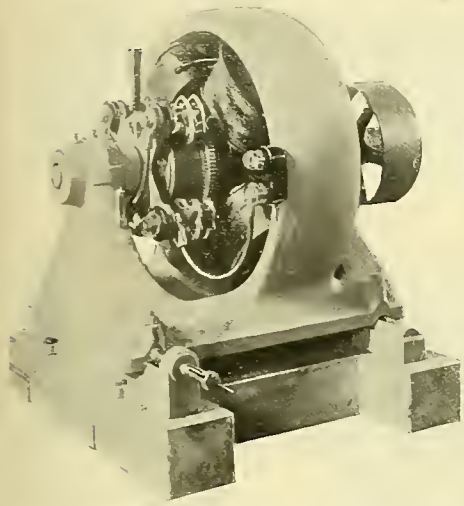
PAINTING POLES, BRACKETS, Cross-Arms, Benches, Floors, etc.

COATING CABLES, Lead-Covered Pipes, and all underground work.

Alcatraz Electrical Compound

Is manufactnred of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. IT WILL NOT SCALE, CRACK OR BURN. PRESENTS A SMOOTH SURFACE. ADHERES TENACIOUSLY. NOT AFFECTED BY THERMAL OR CLIMATIC CONDITIONS. RESISTS THE ACTION OF THE ELEMENTS, ACIDS, ALKALIES, SEWER GASES AND POSSESSES GREAT STRENGTH AND ELASTICITY. Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

Sample Upon Application. Agents Wanted in all Leading Cities.



125 Light Dynamo.—900 R. P. M.

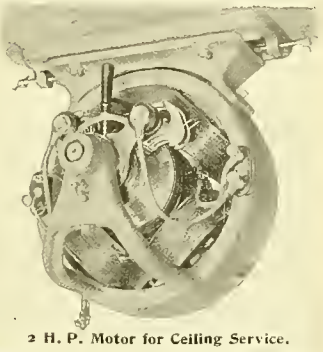
WE HAD TO!

Moved to Cleveland!

The Ahlm-Edwards Electric Co.

We Make Direct-Connected Motors, Slow Speed, up to 70 H. P. Small Motors with Adjustable Base to Save Floor Space.

THE ONLY SHOP MOTOR EVER MADE.



2 H. P. Motor for Ceiling Service.

Westinghouse Electric and Manufacturing Co.,

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PIONEERS IN LONG DISTANCE TRANSMISSION

(TESLA POLYPHASE SYSTEM).

Pioneers in Alternating Current Distribution for Electric Lighting.

THE MOST PROFITABLE CENTRAL STATIONS OPERATE THE WESTINGHOUSE SYSTEM.

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WESTINGHOUSE ELECTRIC COMPANY, Limited,

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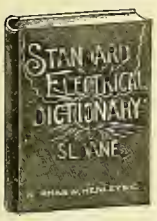
For Canada, Address AHEARN & SOPER, Ottawa, Ont.



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An Excellent Series of Electrical Books.

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FOR THE BEGINNER AS WELL AS THE STUDENT.

Profusely Illustrated. Practical. Necessary Adjuncts to every Library. Send in your Orders.

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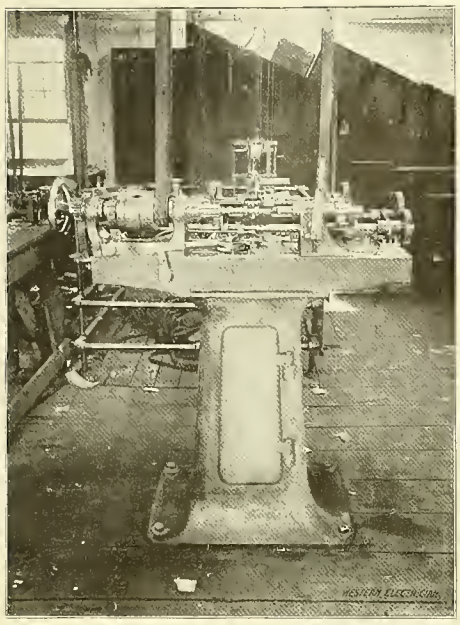
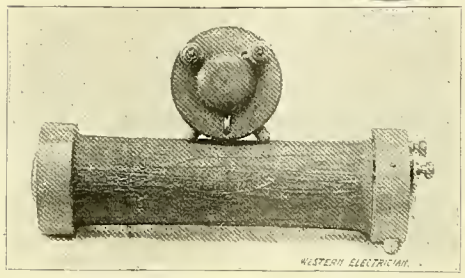
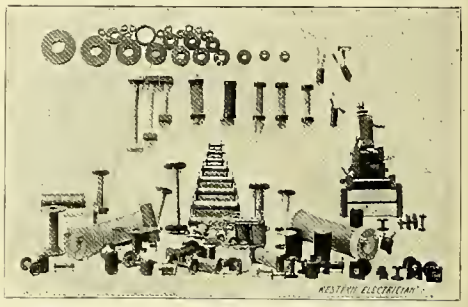


New Armature Winder, made and used exclusively by The Varley Duplex Magnet Co.

ELECTRO Magnets!



Electric Gas Lighting Coils.



Electro Magnets of every description.

The Varley Duplex Magnet Co.,

138 Seventh St., JERSEY CITY, N. J.

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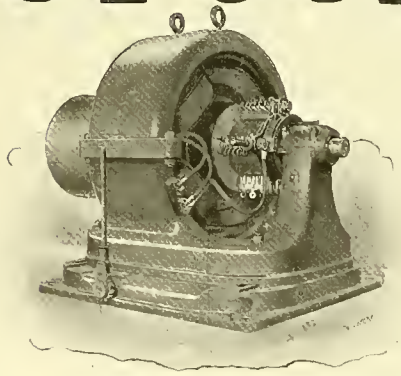

Manufacturers and Electrical Engineers,

39 Cortlandt St., New York and Ampere, N. J.

BUILDERS · OF · High Class Electrical Machinery

Our Installation in the Silversmith Building, Chicago, as illustrated in this issue, is a proof of the *Excellence of our Work* and the *Reliability* of our guarantees.

W. S. Hill Electric Company,

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AGENCIES:

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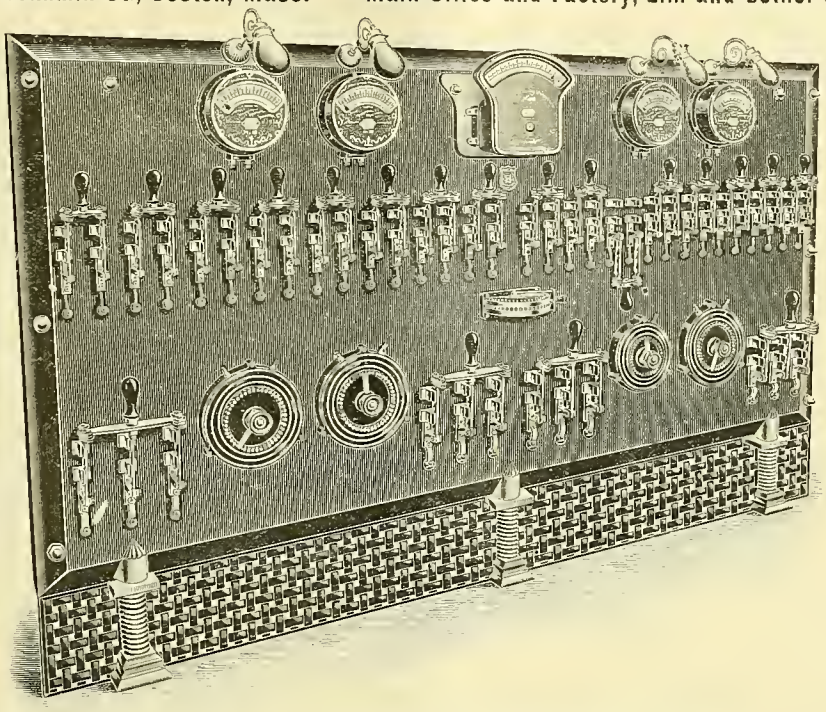
Machado & Roller,
203 BROADWAY, N. Y



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Central Electric Co.,
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Abner Doble Co.,
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LEADING MANUFACTURERS IN THE UNITED STATES OF

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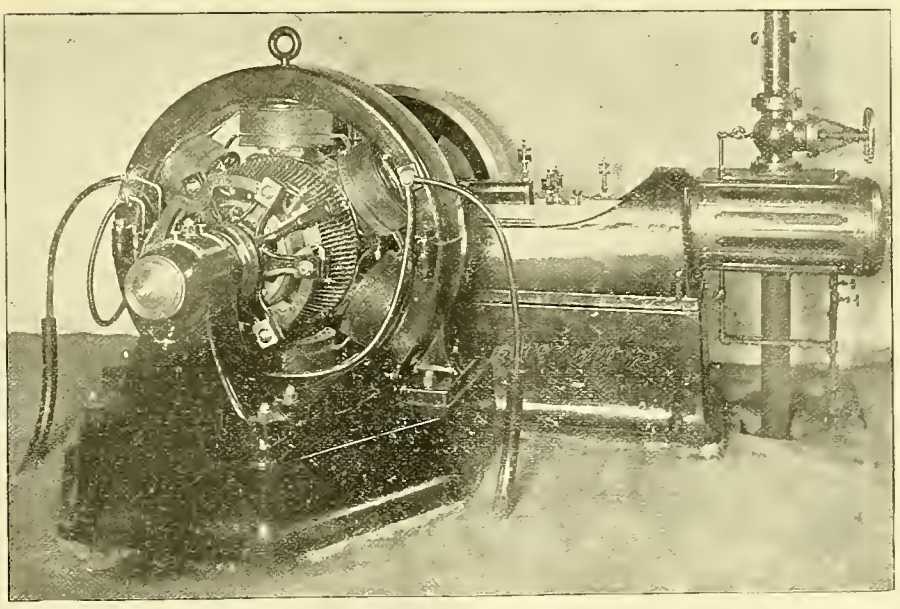
ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES.

ONONDAGA DYNAMO CO.,

FACTORIES: SYRACUSE, N. Y.



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39 CORTLANDT STREET.

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OSBURN ELECTRIC SUPPLY CO.,
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ETHERINGTON & COMPANY,
315-316 FIDELITY BUILDING

SCRANTON, PA., CHAS. B. SCOTT, 119 FRANKLIN AVENUE.

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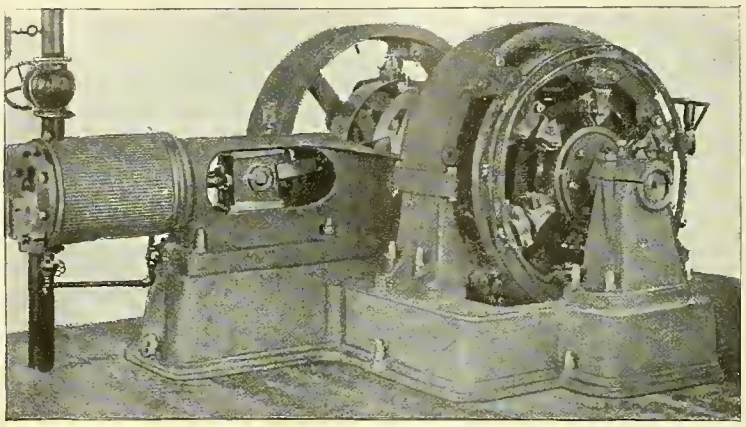

WALKER DIRECT-CONNECTED GENERATOR.

NOT ONLY THE REASONS BUT THE MEANS OF VERIFICATION ARE HERE PRESENTED !!

It Excels in

REGULATION.
SPARKLESS RUNNING UP TO HEAVY OVERLOADS.
SILENT AND SMOOTH RUNNING.

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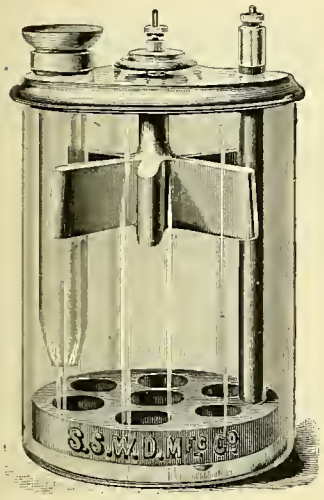

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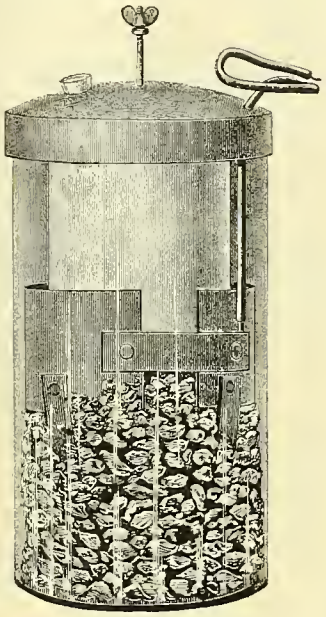

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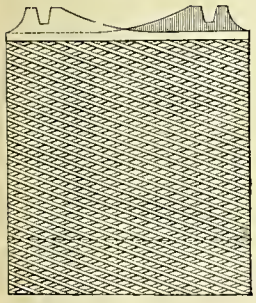

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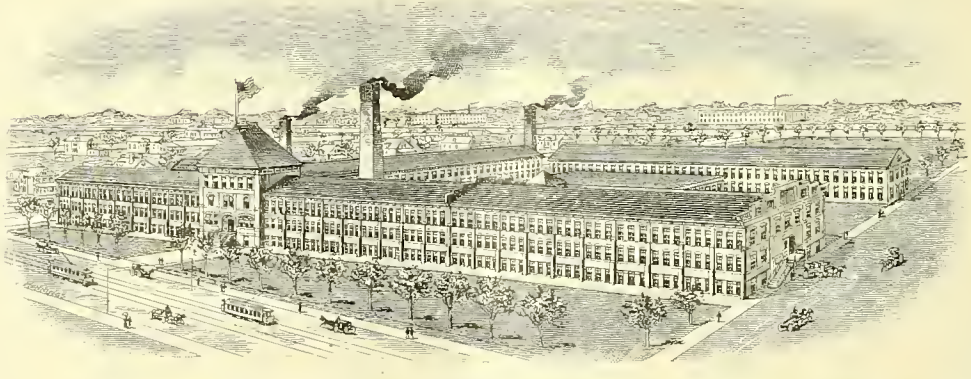

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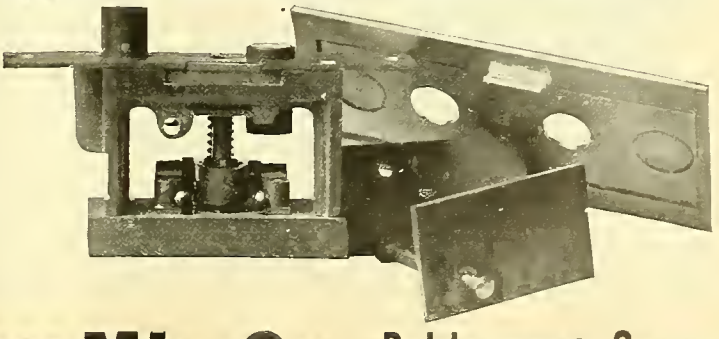

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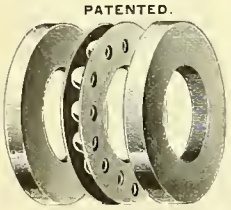

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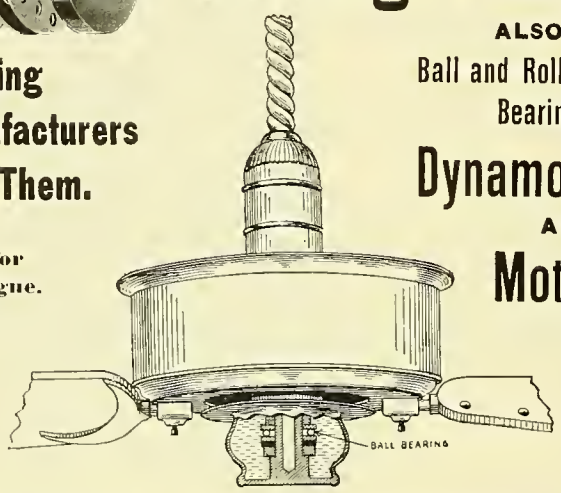

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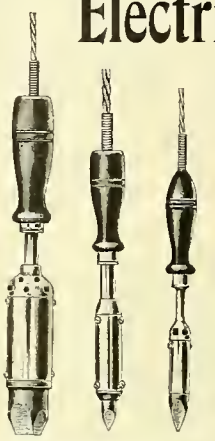

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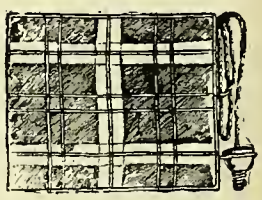

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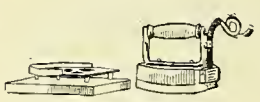

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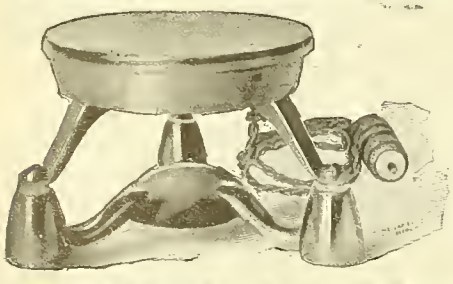

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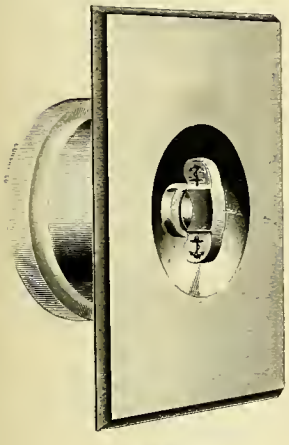

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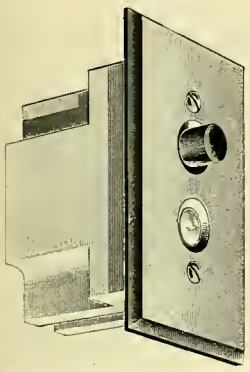

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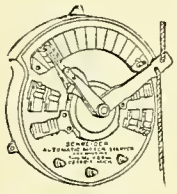

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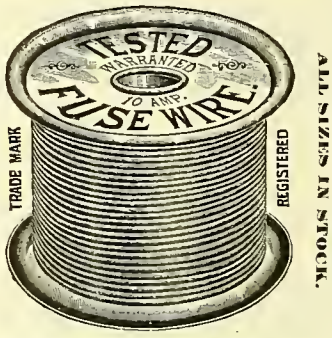

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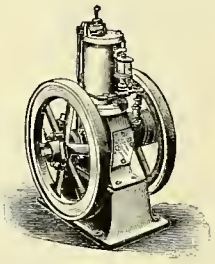

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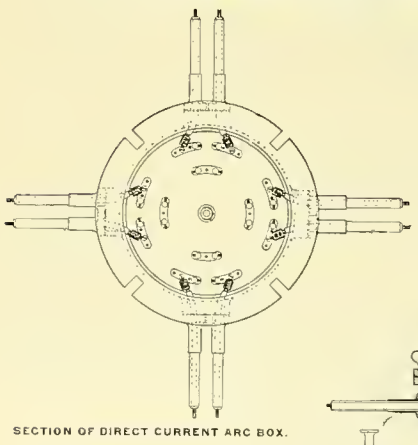

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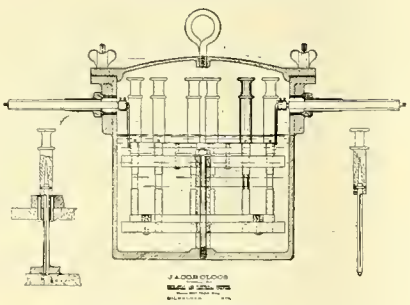

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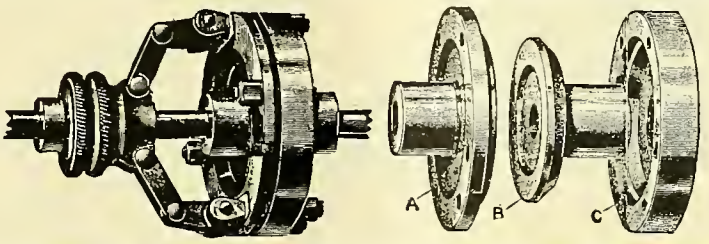

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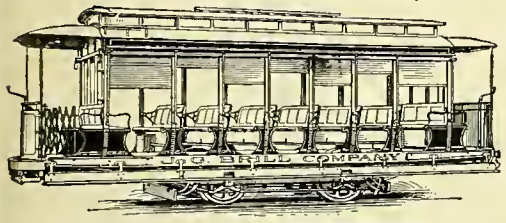

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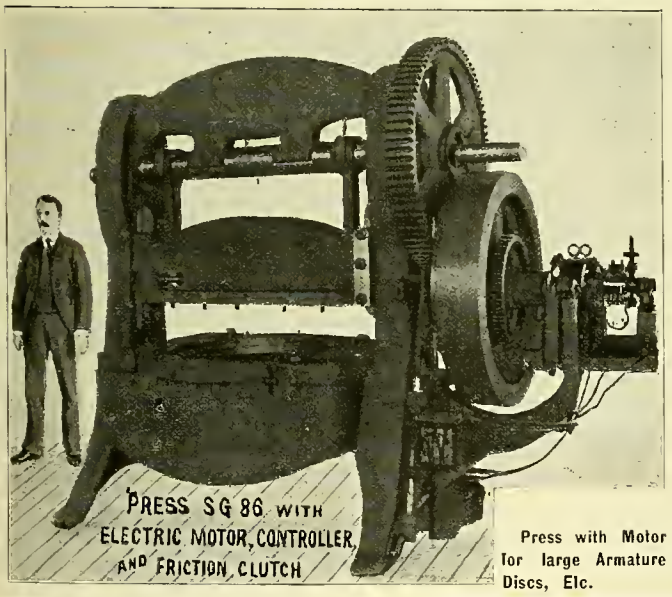

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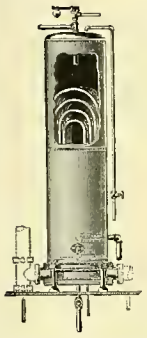

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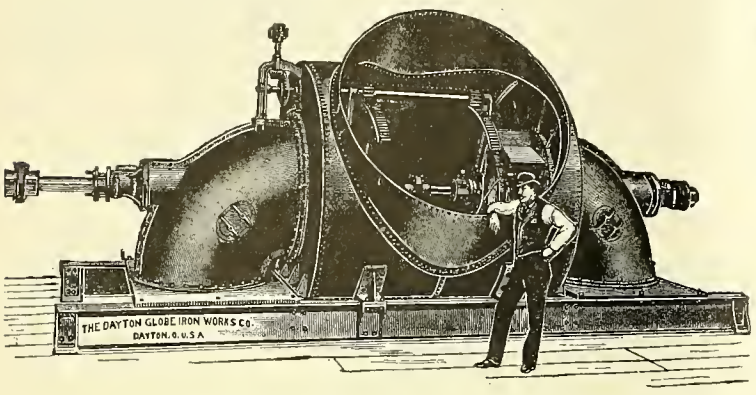

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	Head.	Rev. per Min.	Cu. Ft. per Sec.	H. P.	Per Cent.
Whole Gate	16.06	119.17	141.58	205.27	79.76
⅞ "	16.42	122.00	127.18	195.19	82.68
¾ "	16.78	117.33	112.60	175.74	82.18
⅝ "	17.03	111.83	98.12	149.99	79.31
½ "	16.88	118.67	82.07	118.40	75.62

Test of a 42-inch Wheel—July 14, 1894.

	Head.	Rev. per Min.	Cu. Ft. per Sec.	H. P.	Per Cent.
Whole Gate	16.33	128.00	134.18	199.56	80.60
⅞ "	16.56	134.80	120.85	188.14	83.09
¾ "	16.69	119.33	104.85	162.89	82 77
⅝ "	17.13	125.25	92.76	142.40	79.21
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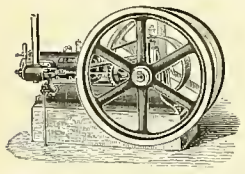

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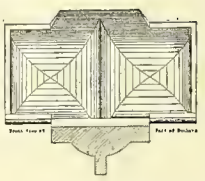

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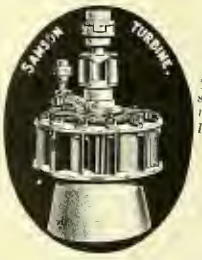

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Full	15.00	144.00	172.69	240.97	82.03
⅞	15.04	138.12	155 03	223.61	84 55
¾	15.11	127.67	133.24	191.06	83.68
⅝	15.88	131.50	112.65	162.80	80 25
½	16.47	126 87	90.04	127.73	75.95

Test of a 35 inch SAMSON, Feb. 1, '97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.29	194 25	102.02	143.44	81.08
⅞	16.56	187.75	92.15	146.73	84.78
¾	17.33	178.50	83.95	138.40	83.88
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½	17.68	168.50	57.69	88.14	76.19

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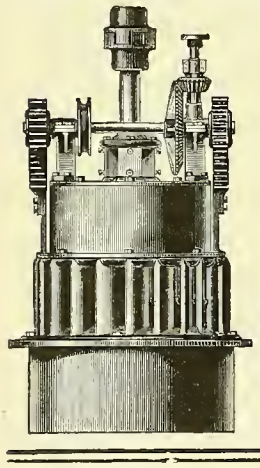

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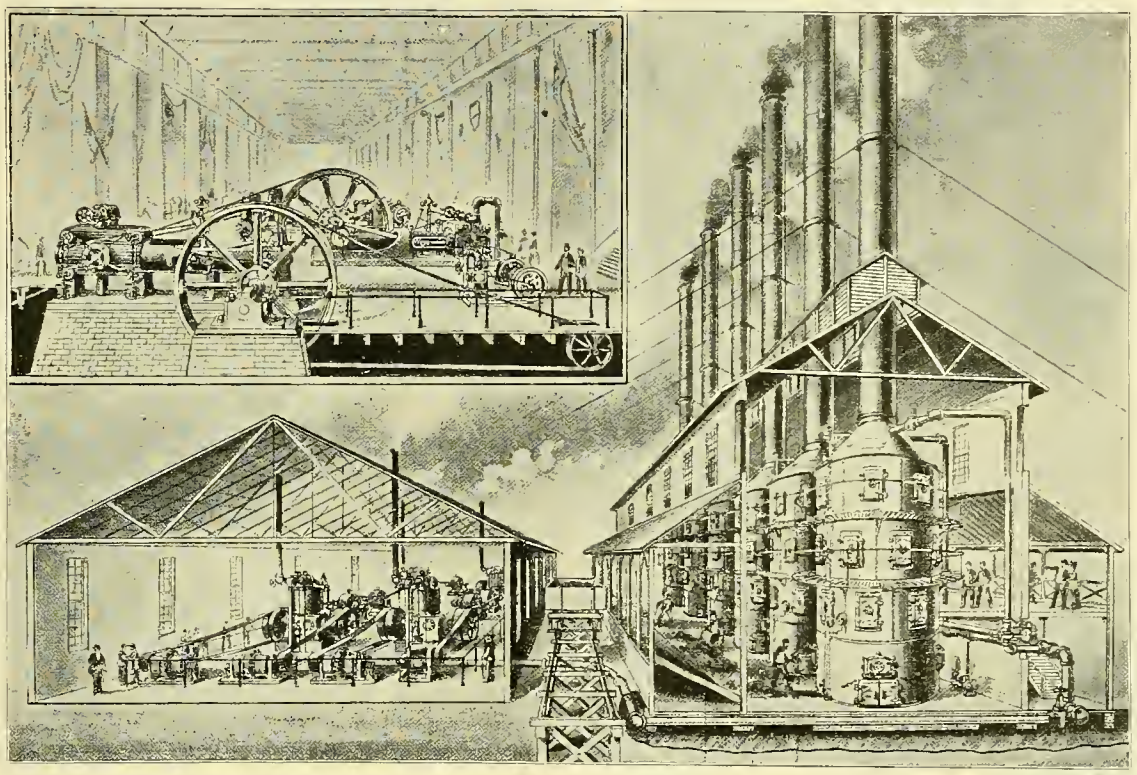

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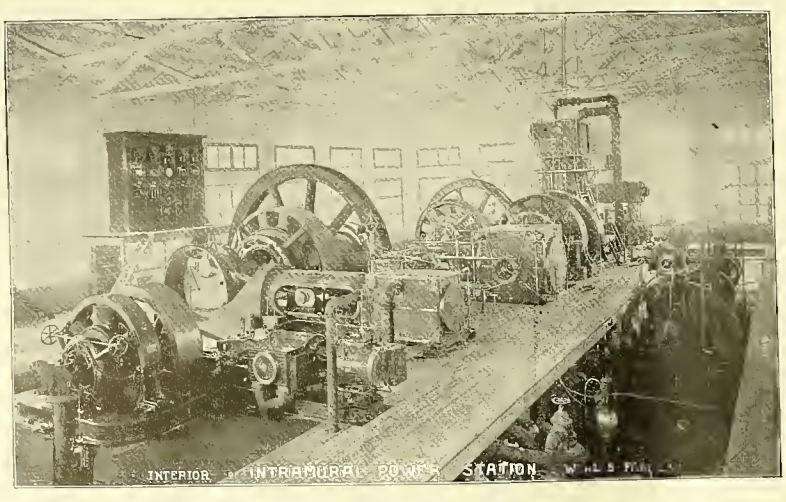

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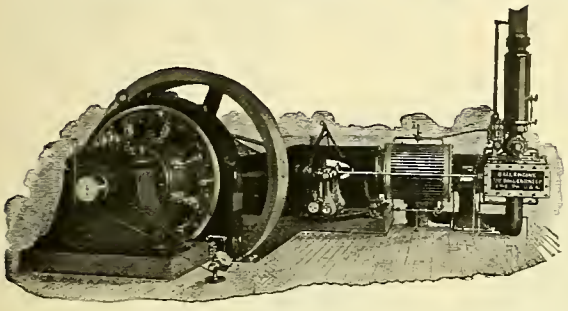

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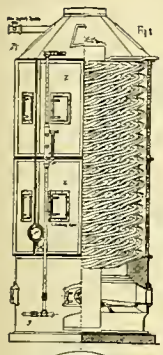

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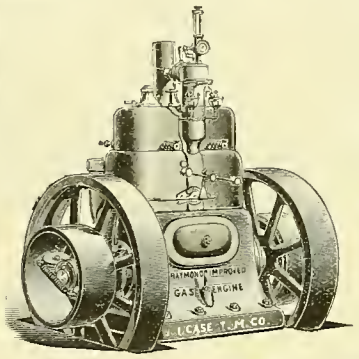

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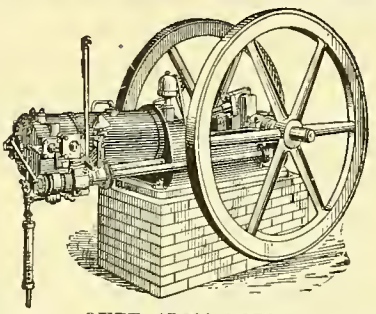

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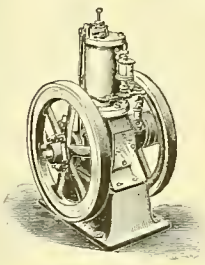

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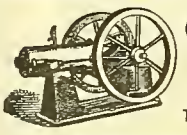

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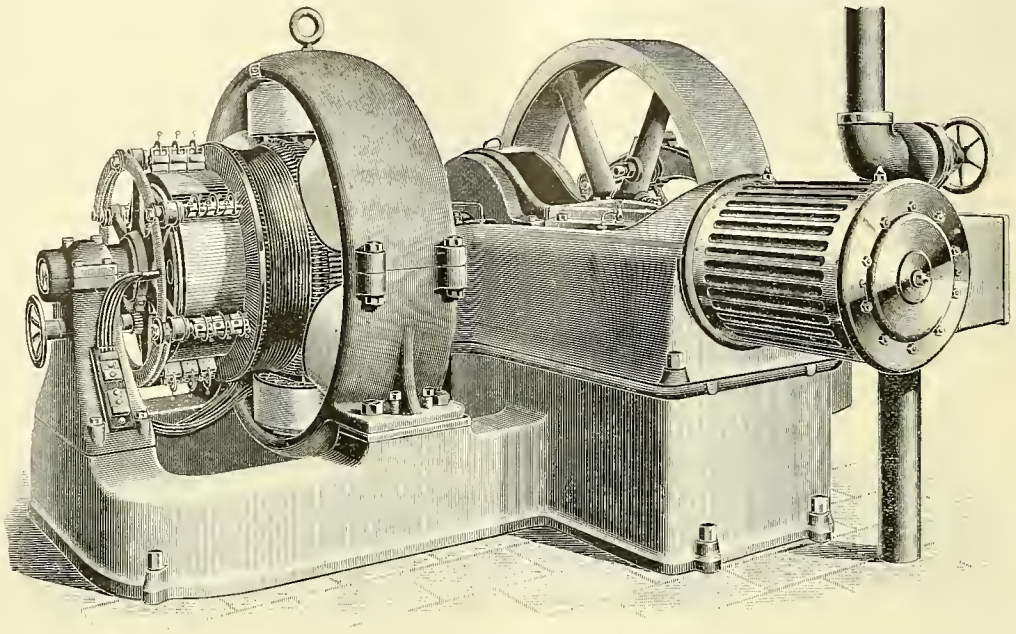

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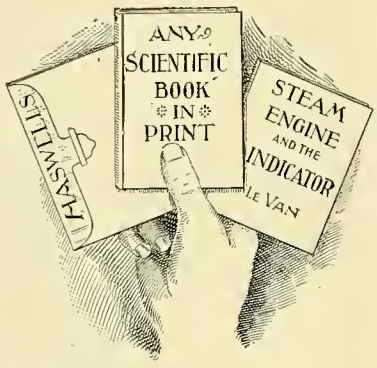

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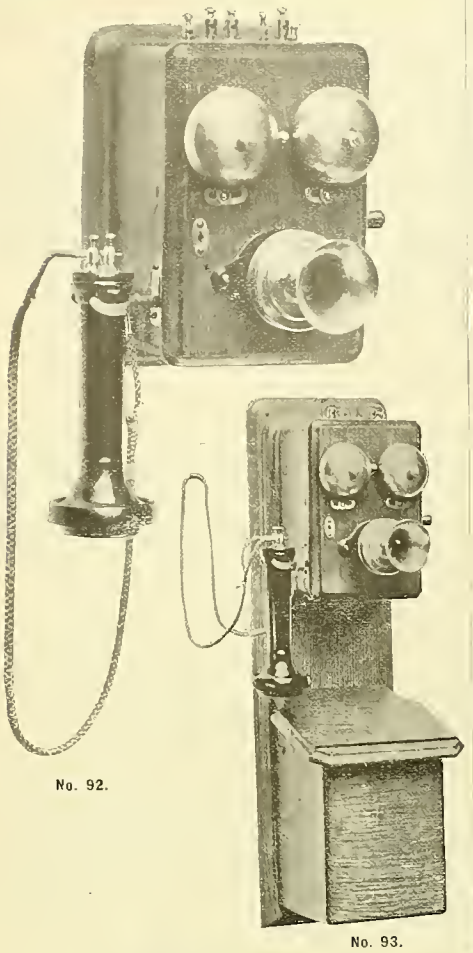

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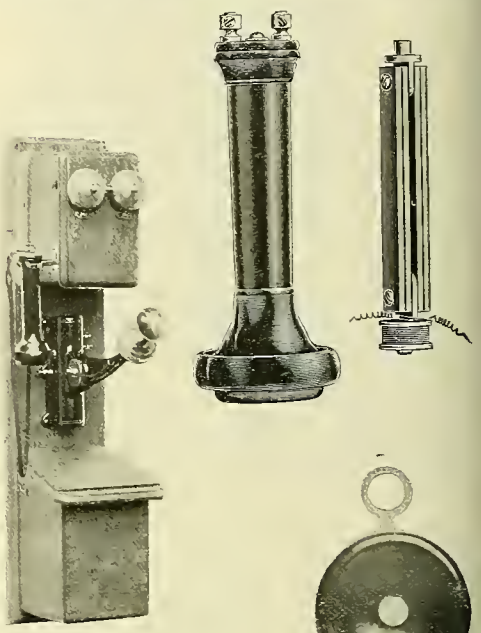

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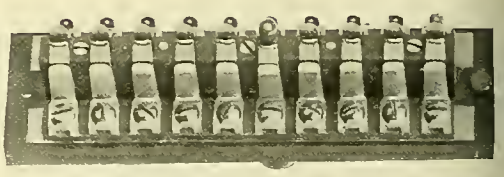

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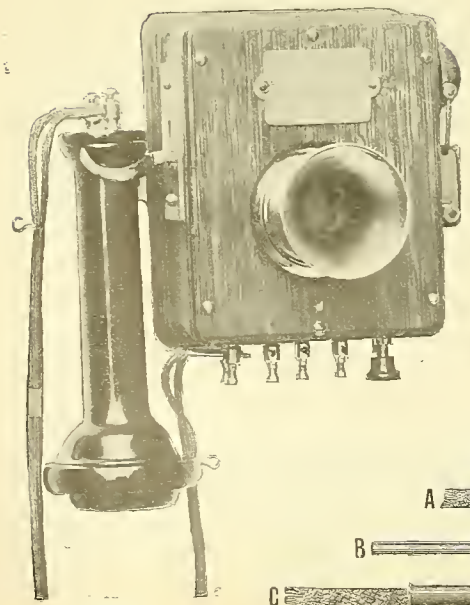

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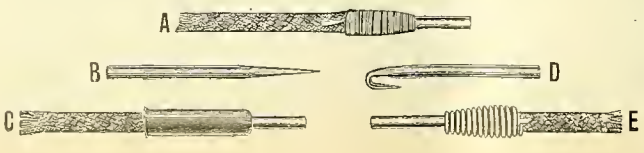

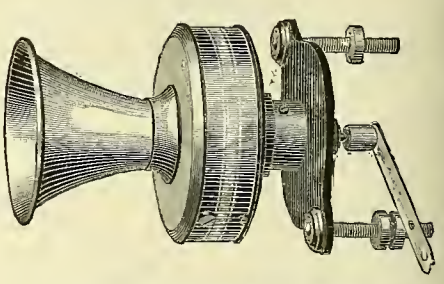

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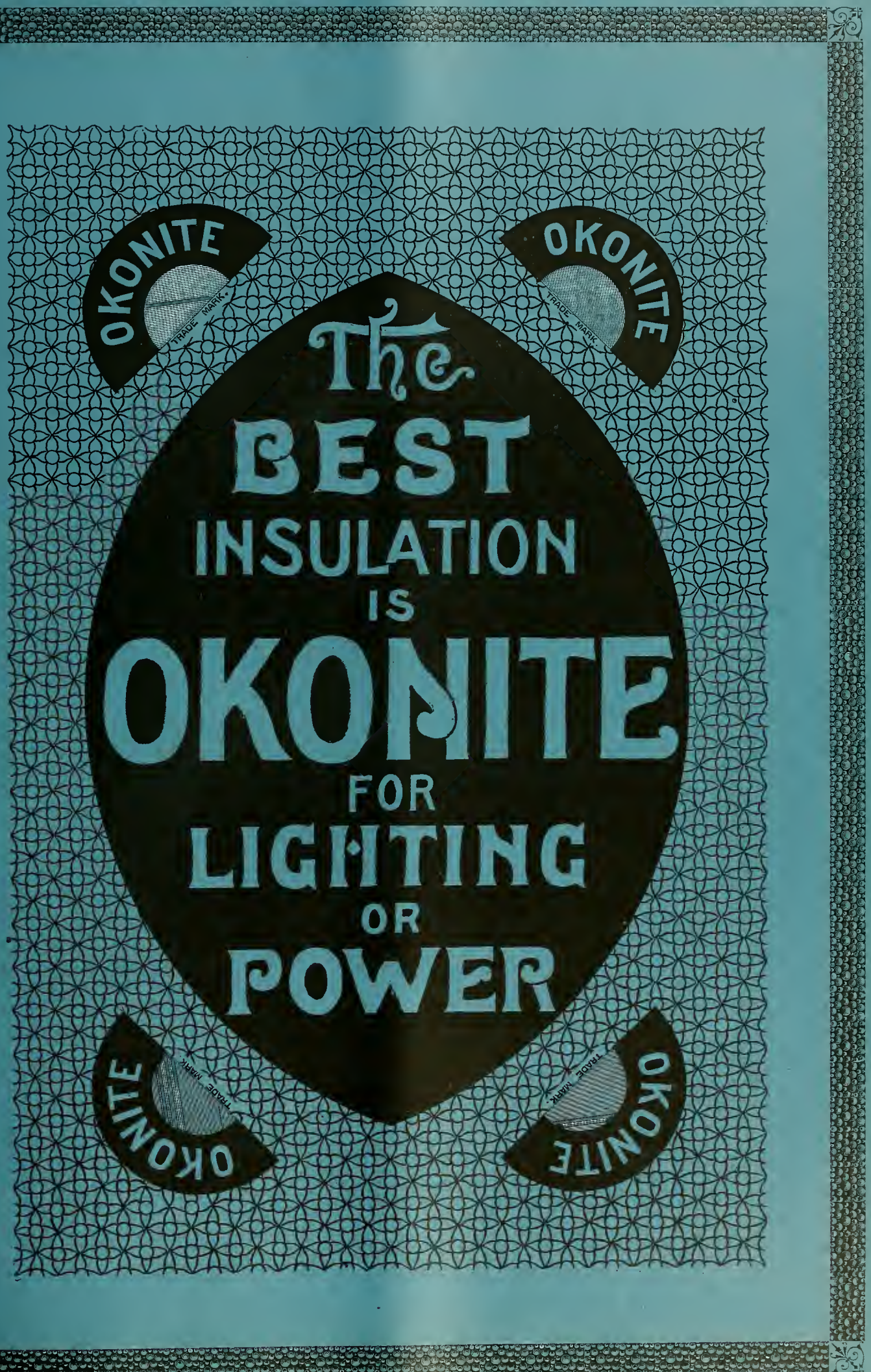
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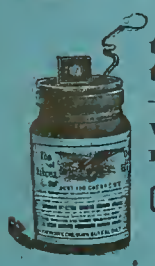

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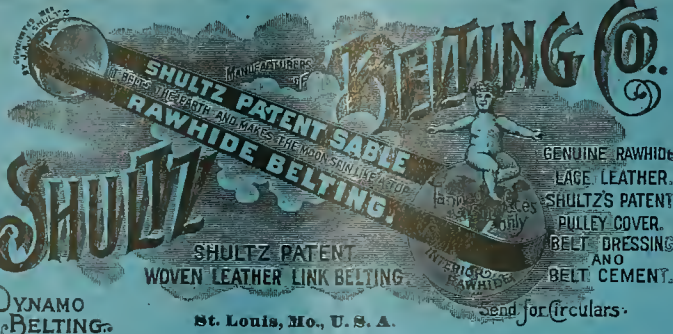

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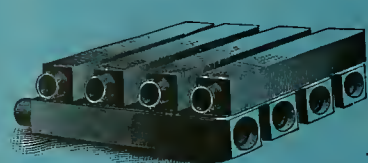

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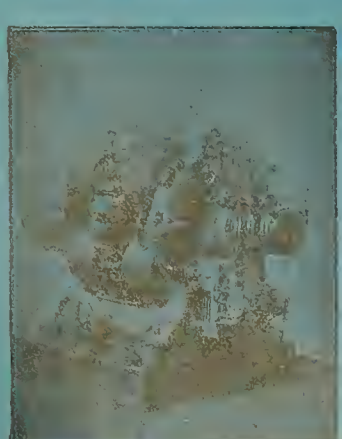

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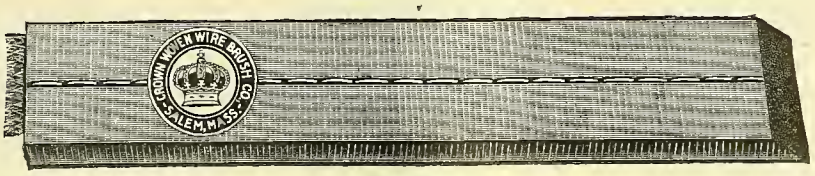

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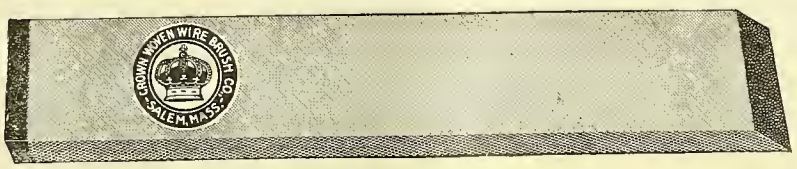

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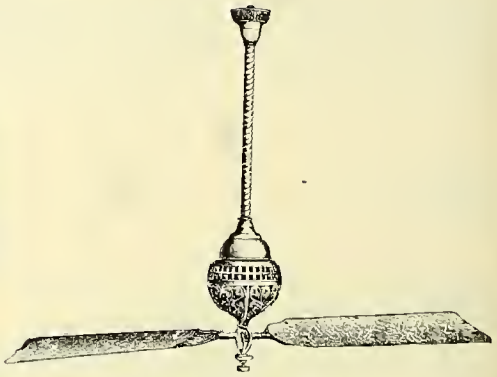

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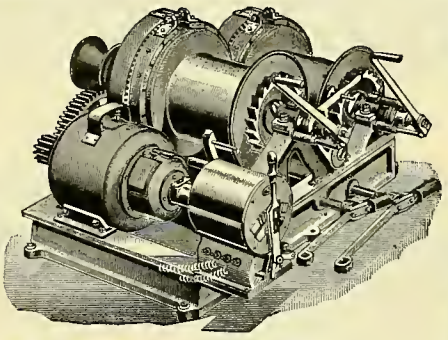

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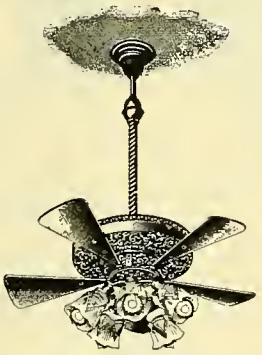

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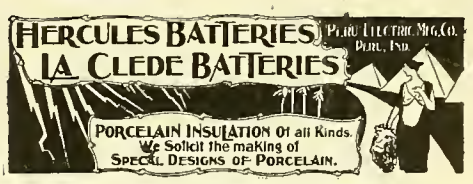

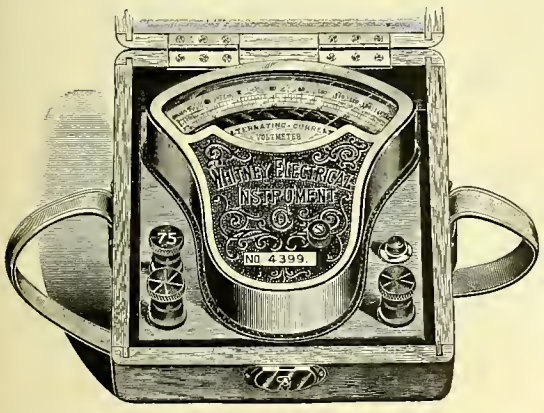

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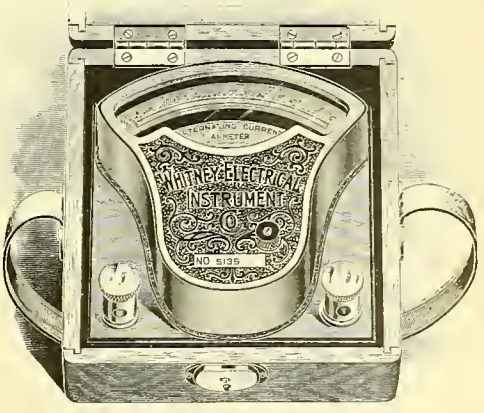

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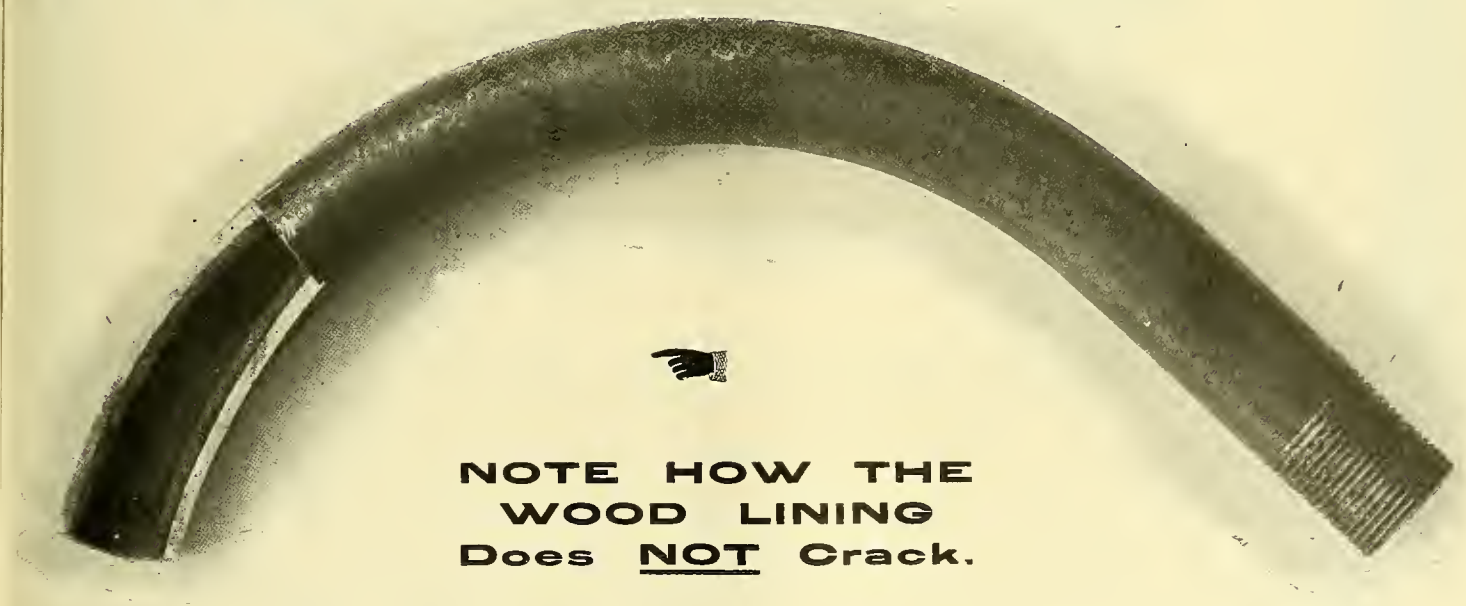

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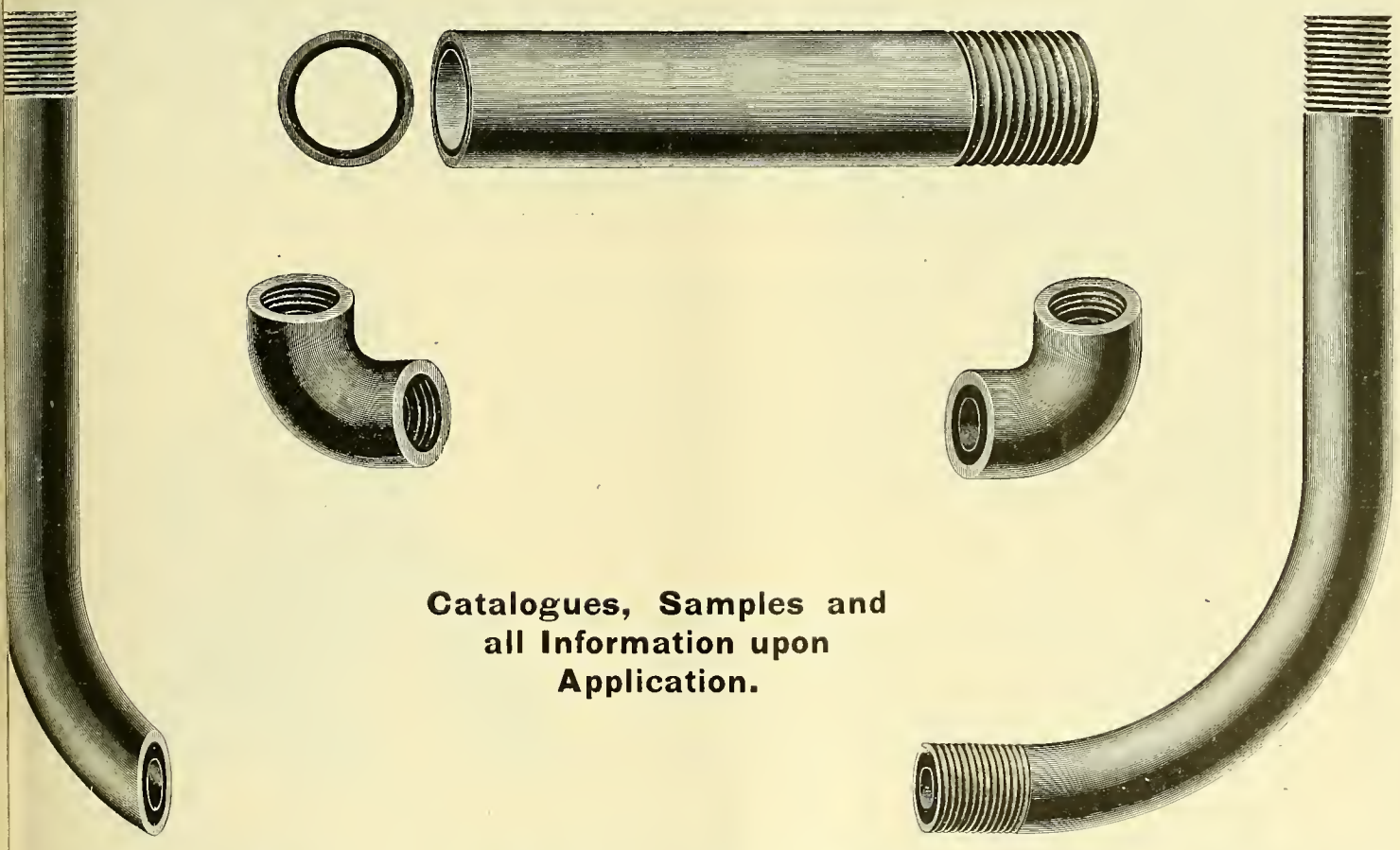

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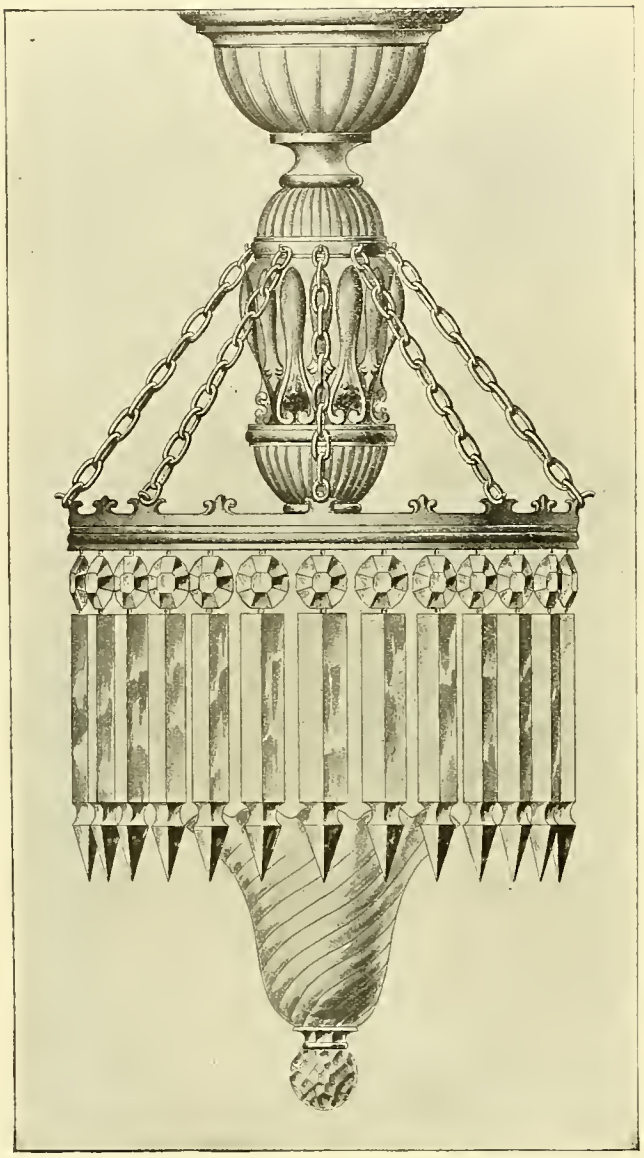

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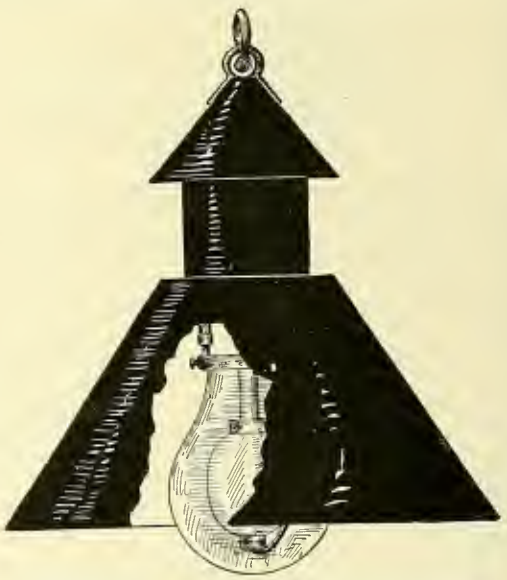

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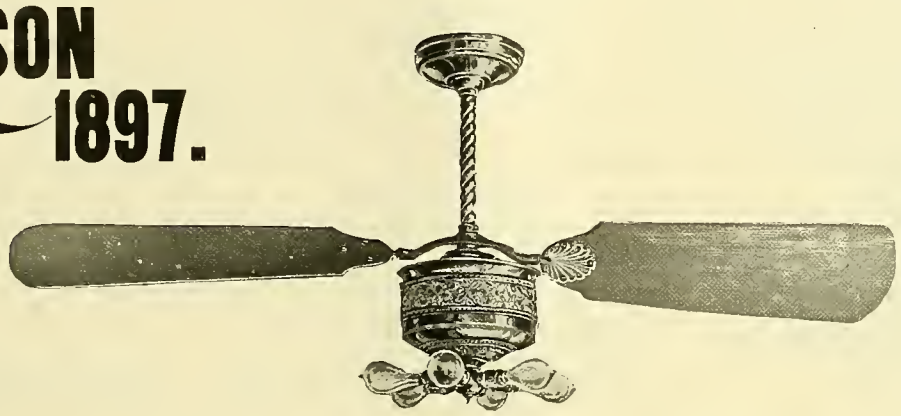

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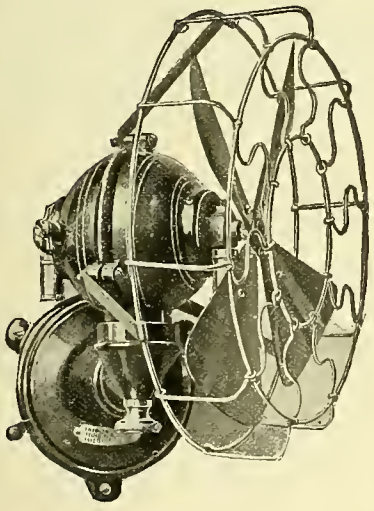

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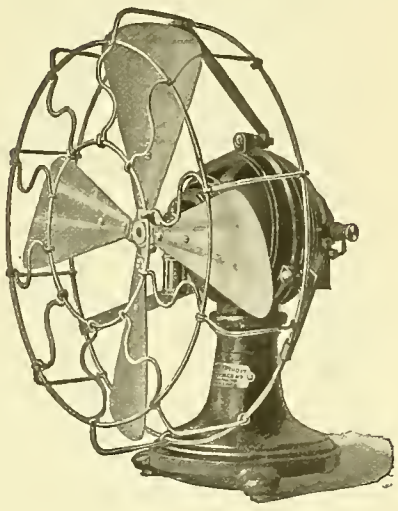

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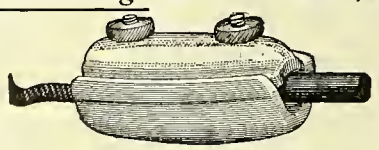

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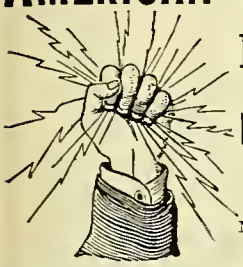

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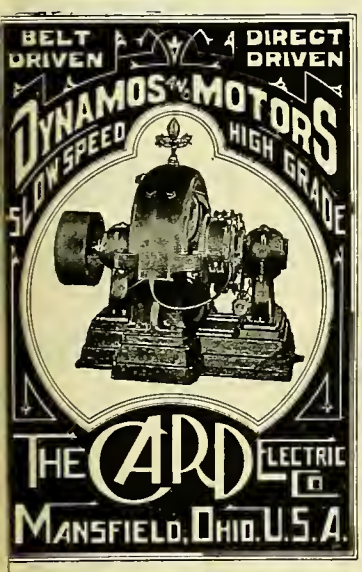

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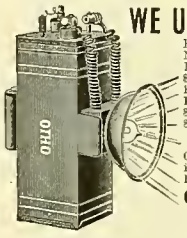

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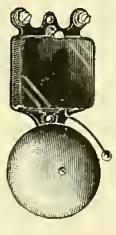

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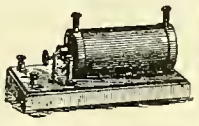

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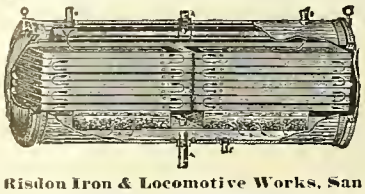

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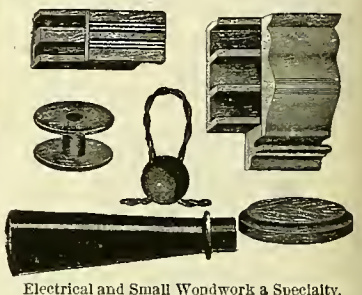

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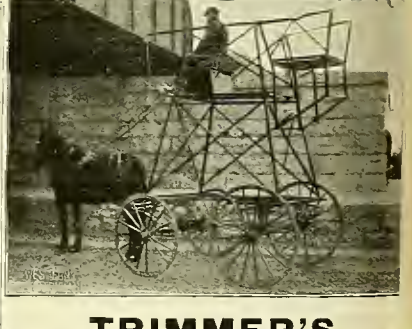

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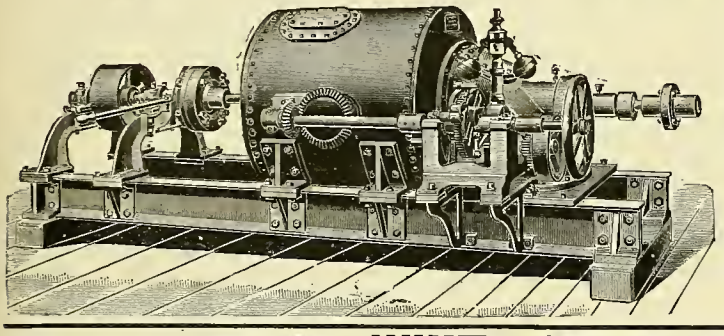

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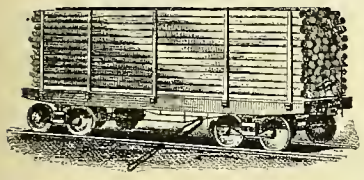

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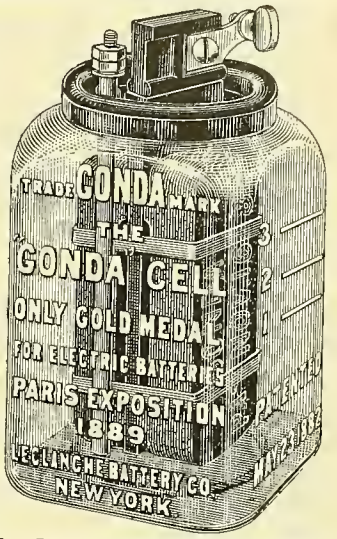

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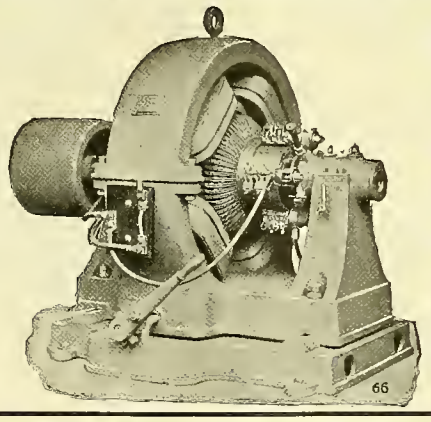

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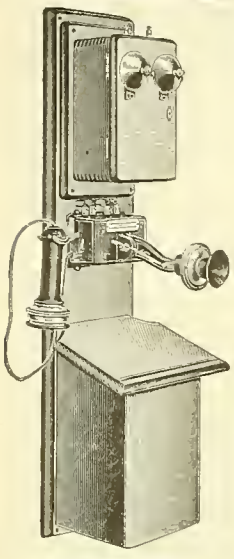

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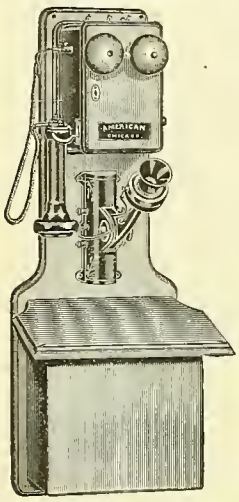

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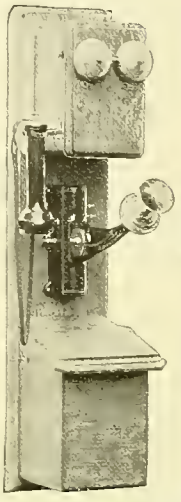

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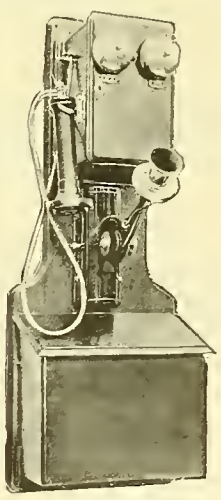

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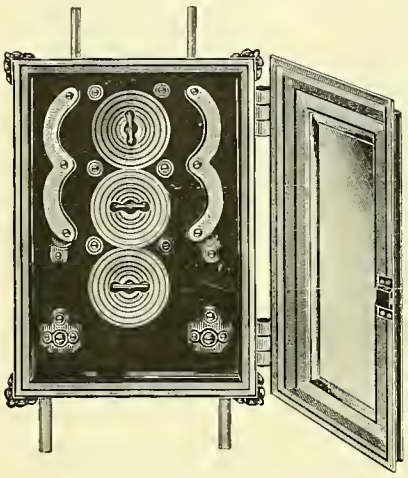

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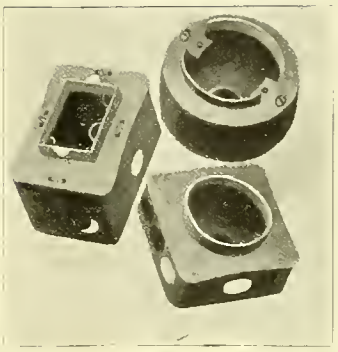

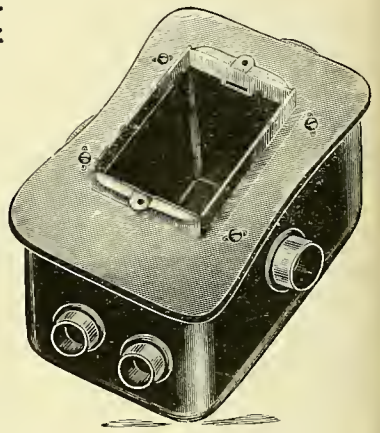

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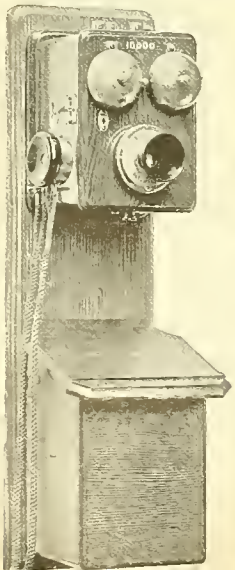

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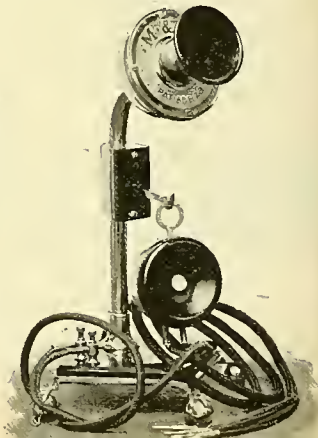

185 Franklin St. Boston, Mass.

A Statement Relative TO THE Telephone Situation.

Even though the issuance of the Berliner patent is proper, the fact that the patent is invalid is so conclusive and definite as based on existing evidence, that we regret the general misapprehension of the subject and take advantage of the opportunity to offer protection to the users of the Connecticut Telephone & Electric Company's apparatus, and we **STAND READY AND WILL DEFEND AT OUR OWN EXPENSE ANY SUITS BROUGHT AGAINST USERS OF OUR APPARATUS FOR ALLEGED INFRINGEMENT.**

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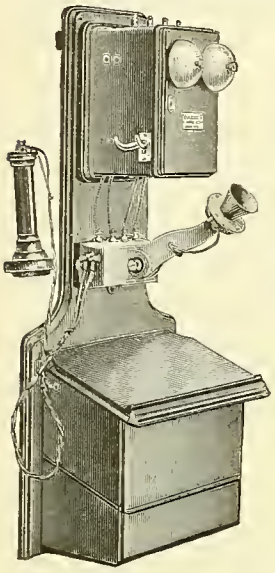

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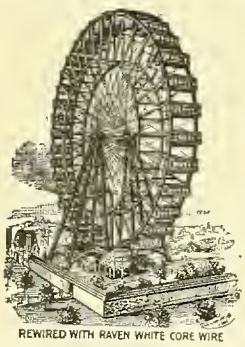

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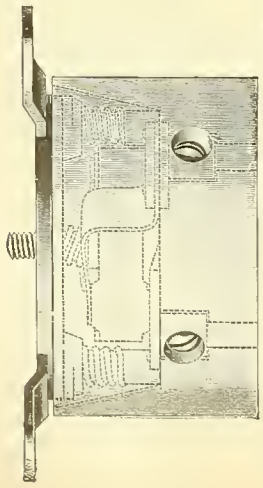

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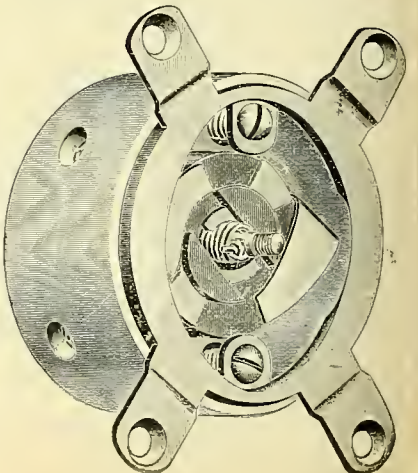

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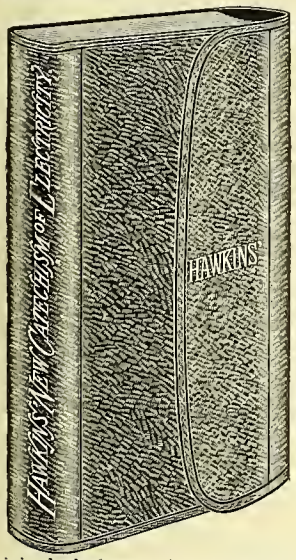

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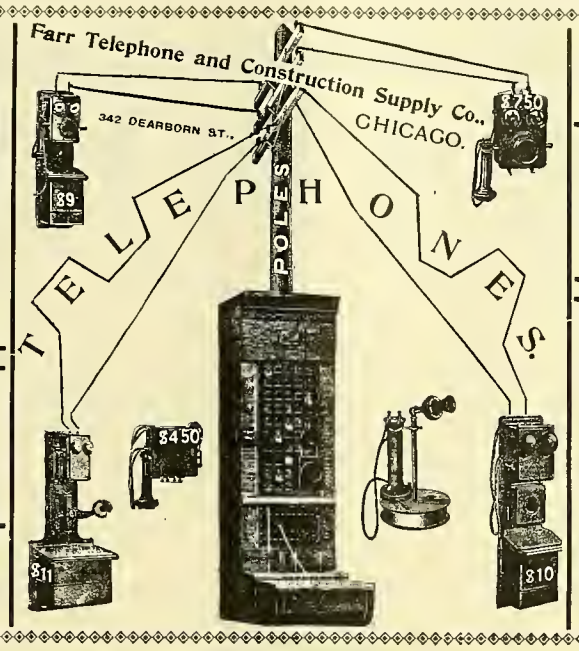

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Is protected by letters patent No. 528640 and No. 557588, issued Nov. 6, 1894, and April 7, 1896, respectively.

The electrodes have "A variable air space" between them, and the adjustment is obtained by tension instead of pressure. The Lockwood is positively the only Transmitter on the market having no contact BETWEEN electrodes, consequently parties liable to infringement suits and promoters of long-distance systems will find it to be the only telephone that will satisfy the fears of their subscribers. The Transmitter can be placed upon any instrument now in use, and an exchange of Transmitters is easily effected.

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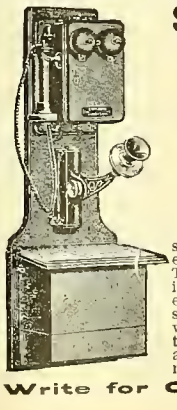

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CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Phila.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

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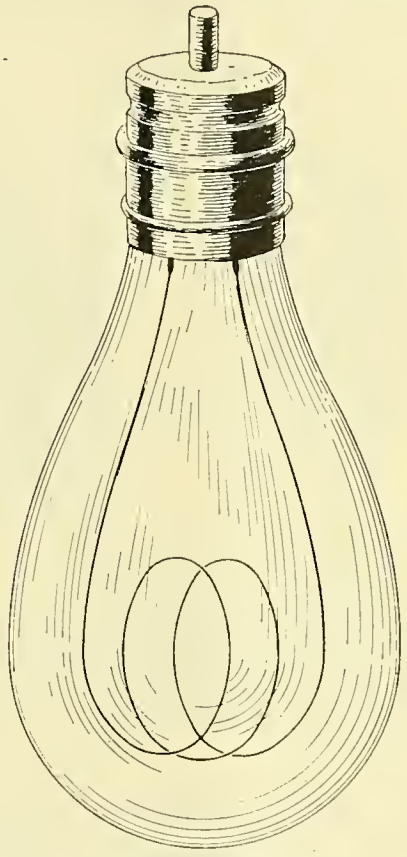
SUPERIOR IN EFFICIENCY, LIFE AND SUSTAINED CANDLE POWER.



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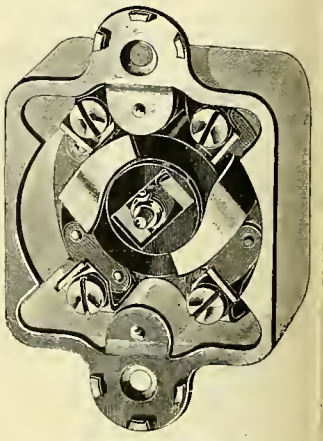
TO THE TRADE:

Our attention has recently been called to letters received by customers of ours from The Perkins Electric Switch Manufacturing Company intimating that certain switches manufactured by us, we assume, infringe a patent owned by that company, and threatening dealers handling such switches with suits for the infringement of said patent. We assume that the patent referred to in these threatening letters is that numbered 517,100, dated March 27, 1894, and granted to Jacob S. Gibbs, assignor to The Perkins Electric Switch Manufacturing Company, for Electric Switch, and that the switches manufactured by us and aimed at in these letters are those now known as the "Hartford" switches.

We wish to assure dealers that, should any suit be brought against them by The Perkins Electric Switch Manufacturing Company for alleged infringement of the patent above referred to, because of their handling said switches, we stand ready to assume the defense of such suits and to indemnify them against any recovery by that company against them for such infringement. Respectfully yours,

THE GIBBS ELECTRIC MFG. CO.



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Are made on the

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May 10, 1897.

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GENTLEMEN:—We have compared the switch known as the "Hartford" switch manufactured by you, with letters patent of the United States granted to Jacob S. Gibbs, assignor to The Perkins Electric Switch Manufacturing Company, No. 517,100, dated March 27, 1894, and in our opinion said switch does not, in view of the state of the art, infringe any of the claims of said letters patent Respectfully,

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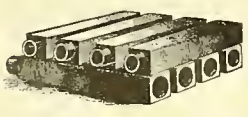

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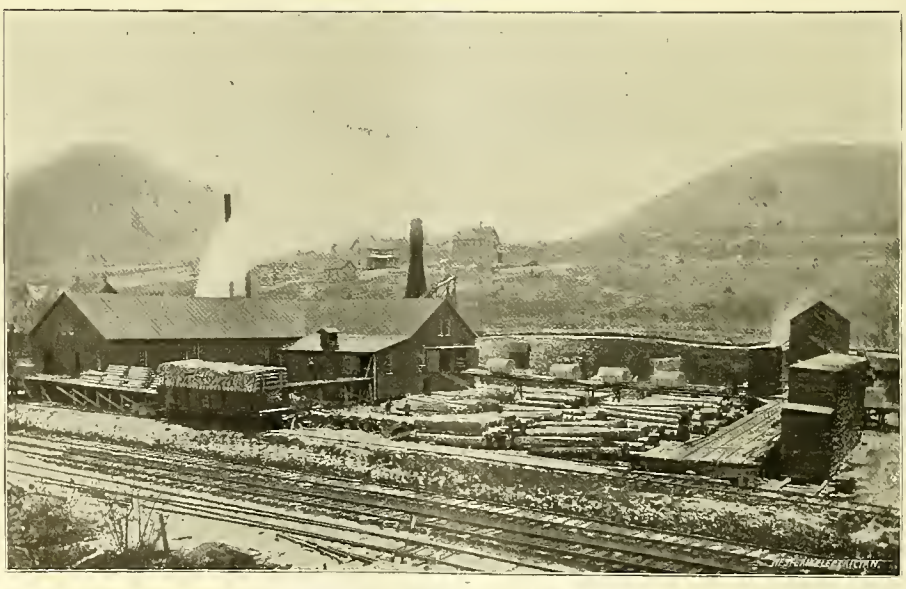

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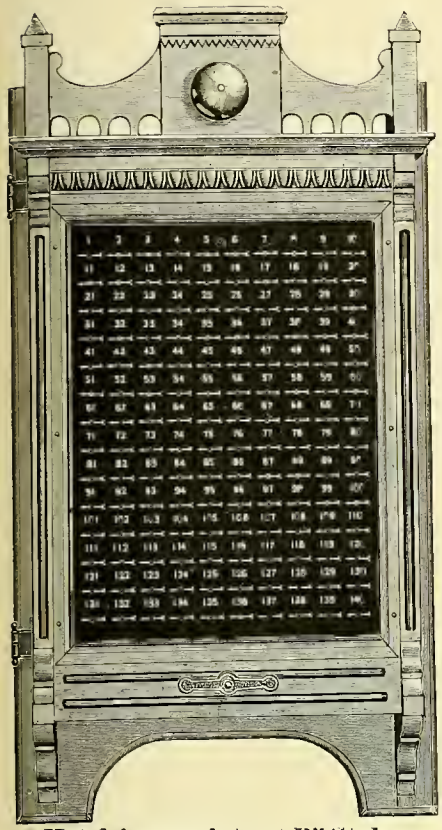

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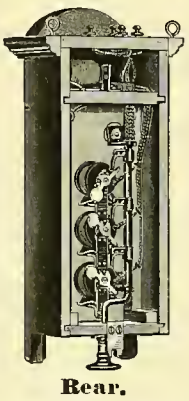

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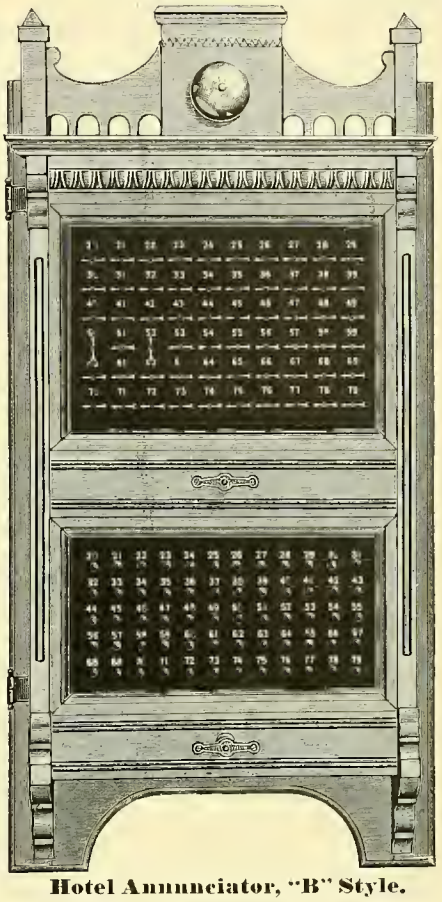

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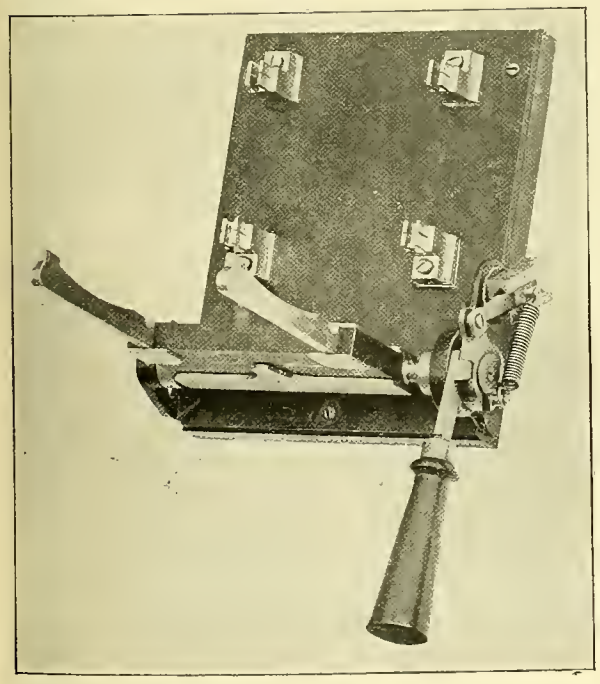

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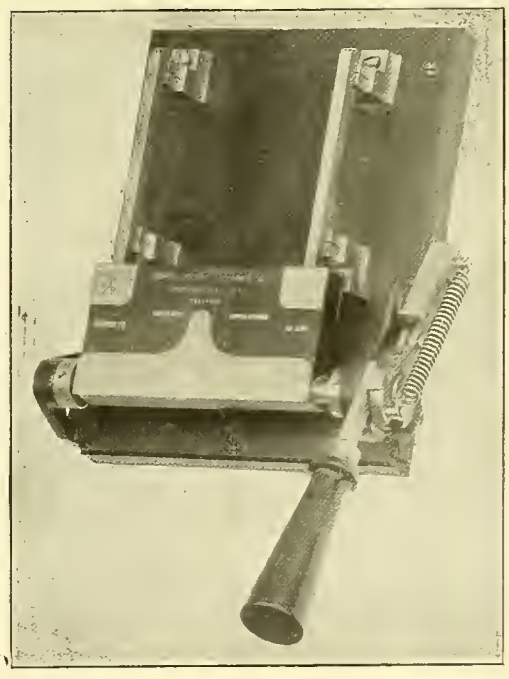

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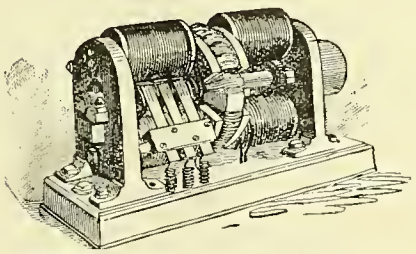

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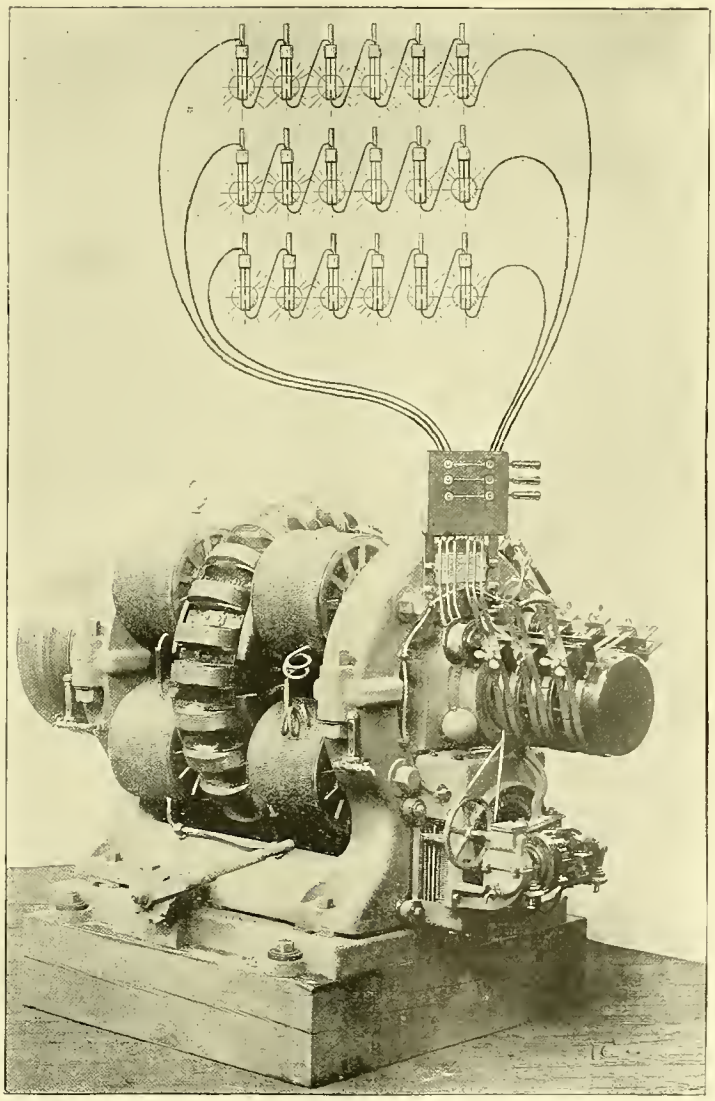

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CHAPTER XXXI. **Model Electric Plants.**—First Central Station; Changes in General Mechanical Construction of Dynamos; Instruments; Multiple Arcing Galvanometers; Use of Double and Single Pole Switches; Operating Dynamos in Parallel; Feeder Connections in Continuous and Alternating Stations; Throwing Dynamo into Circuit; Cutting Dynamo Out.

CHAPTER XXXII. **Underwriter's Rules, Etc.**—Necessity of Rules; Special Points in Wiring; Insulation of Sockets, Fuses, Fixtures; Annunciator Wire; Office Wire; Leaky Wires.

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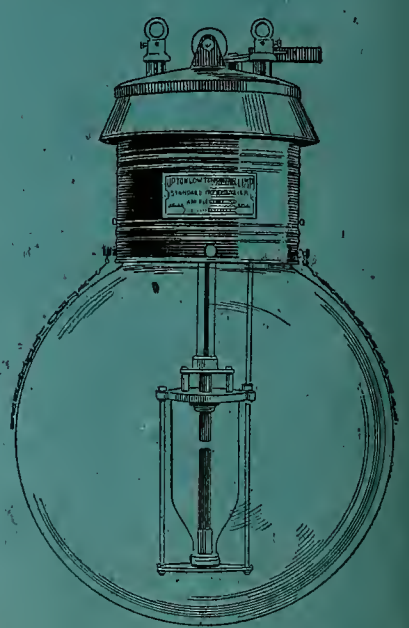

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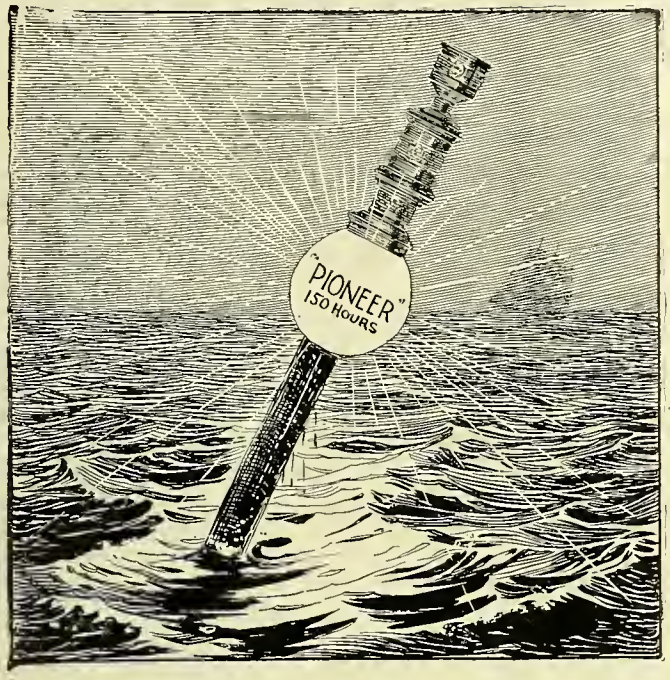

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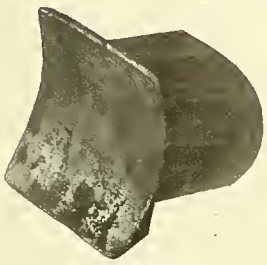
DIRECT CURRENT.



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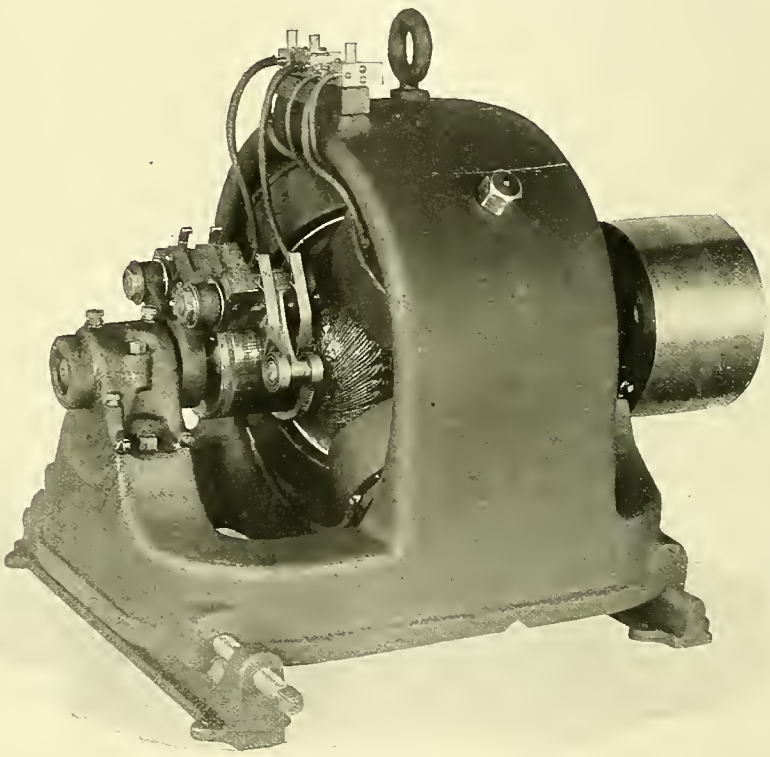

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Moderate Speed—1.5 to 20 H. P.

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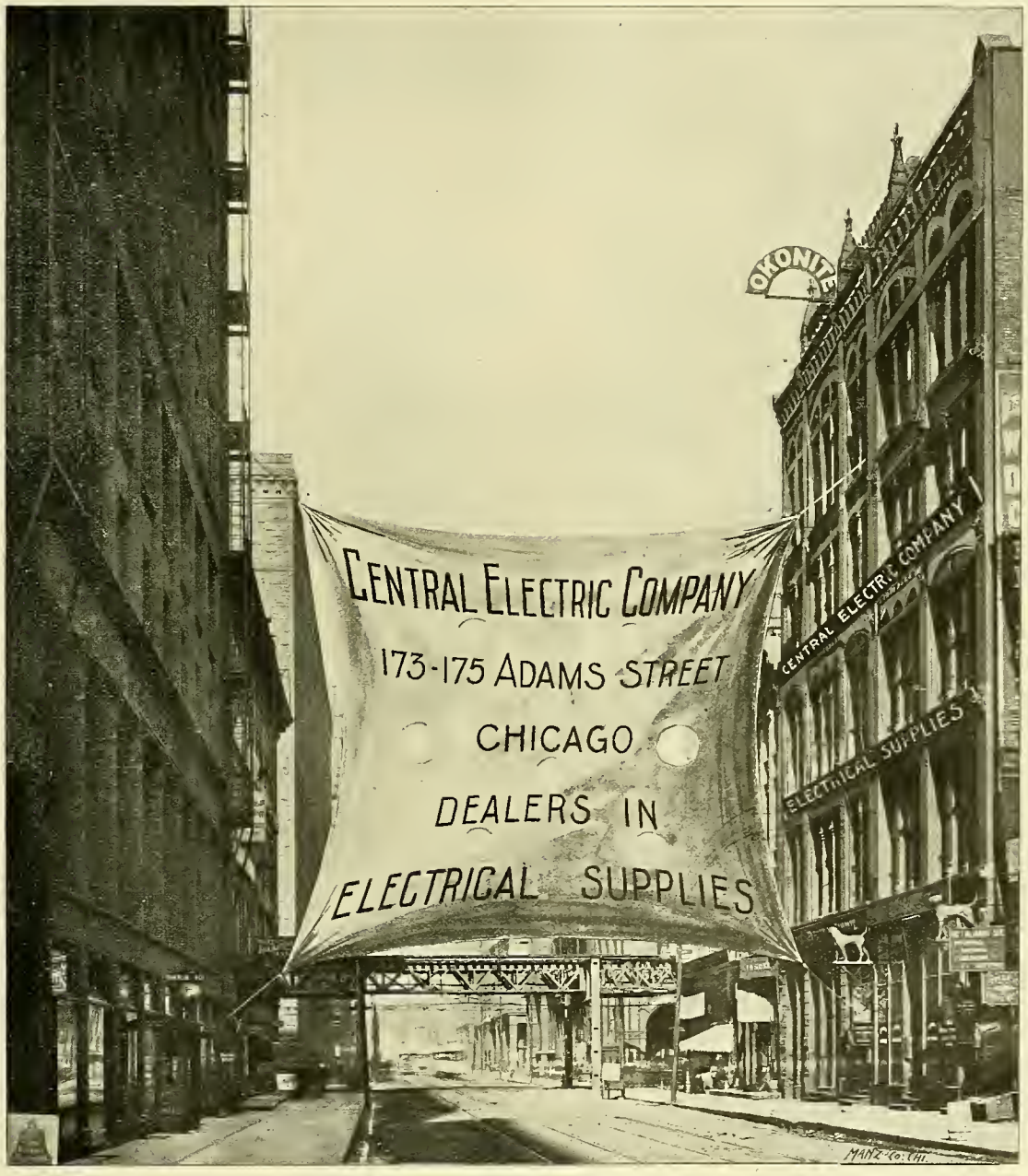
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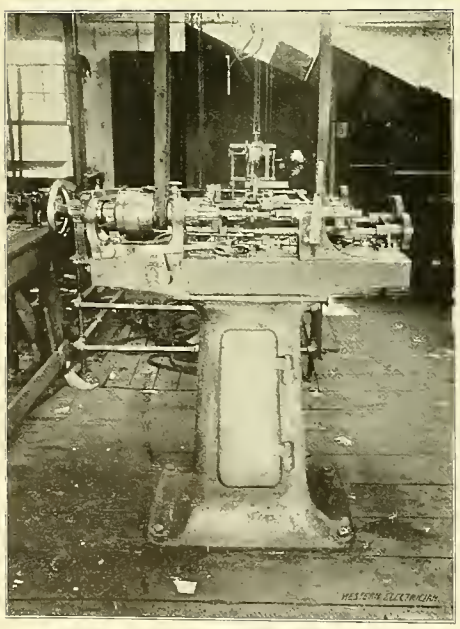

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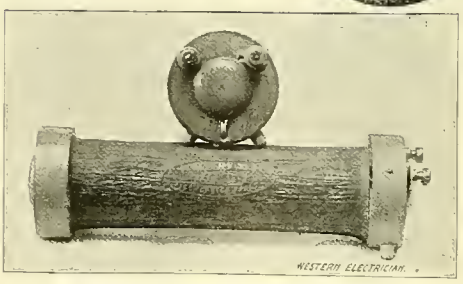

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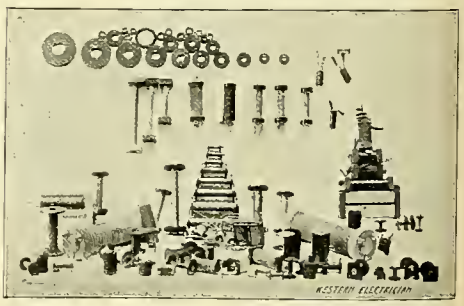

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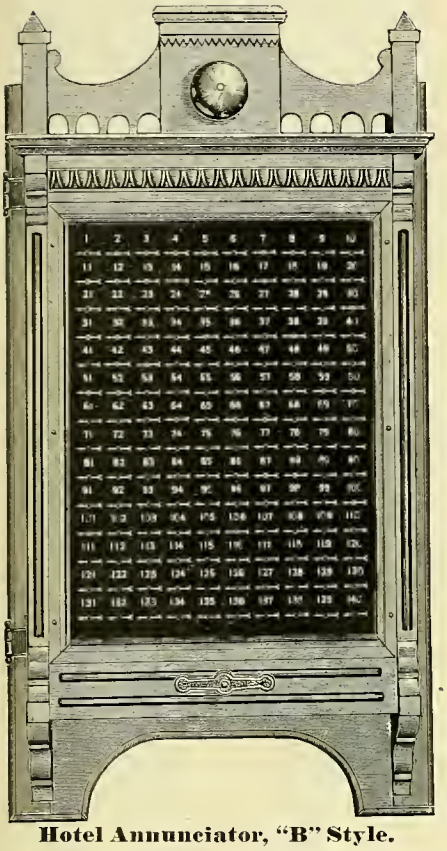
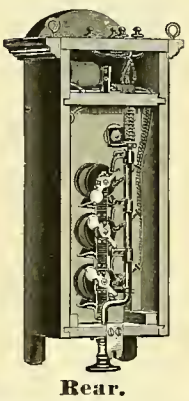
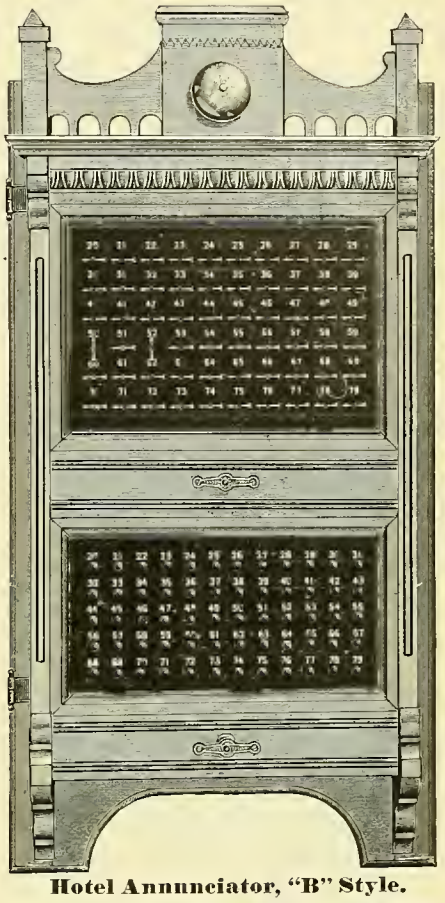


Hotel Annunciator, "B" Style.

Front.



Rear.



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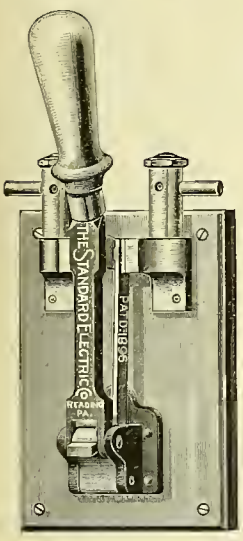
There are QUICK BREAK and Quick Brake

SWITCHES.



We do not hesitate to say that the Engineering conditions which

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Offers, its remarkably QUICK BREAK, will make it

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To be Done in the Future by ELECTRICIANS.

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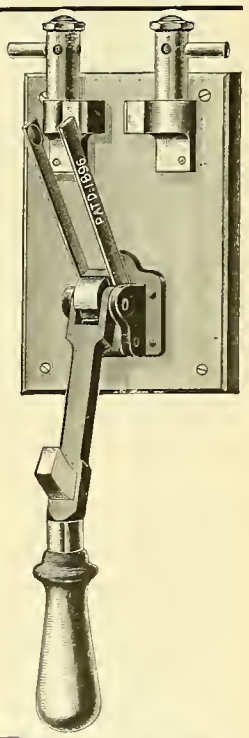

The Standard Automatic Time Cut-Out

May be set to open circuit at any time of day or night.

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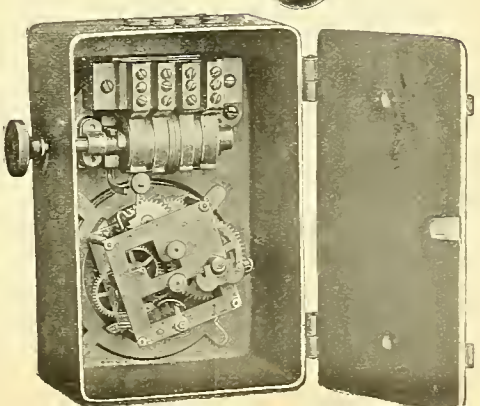

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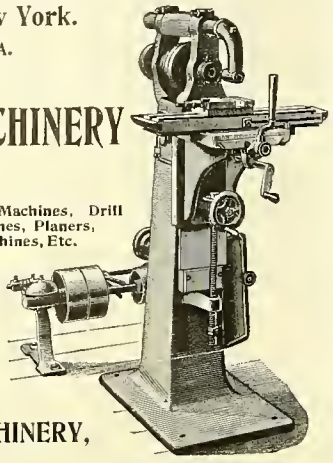

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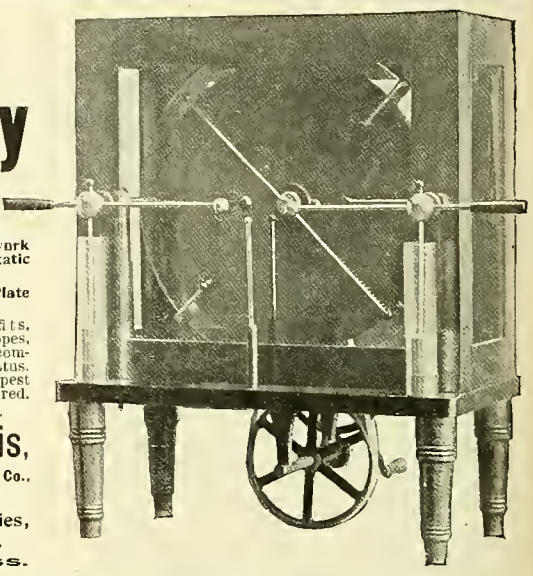

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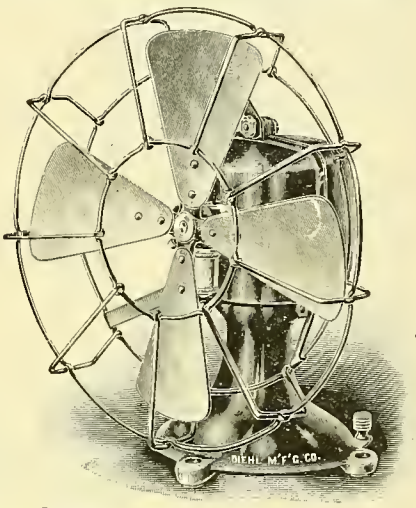

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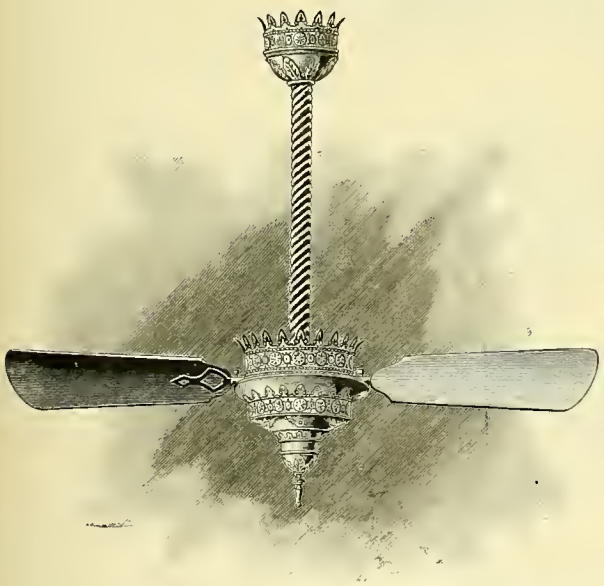

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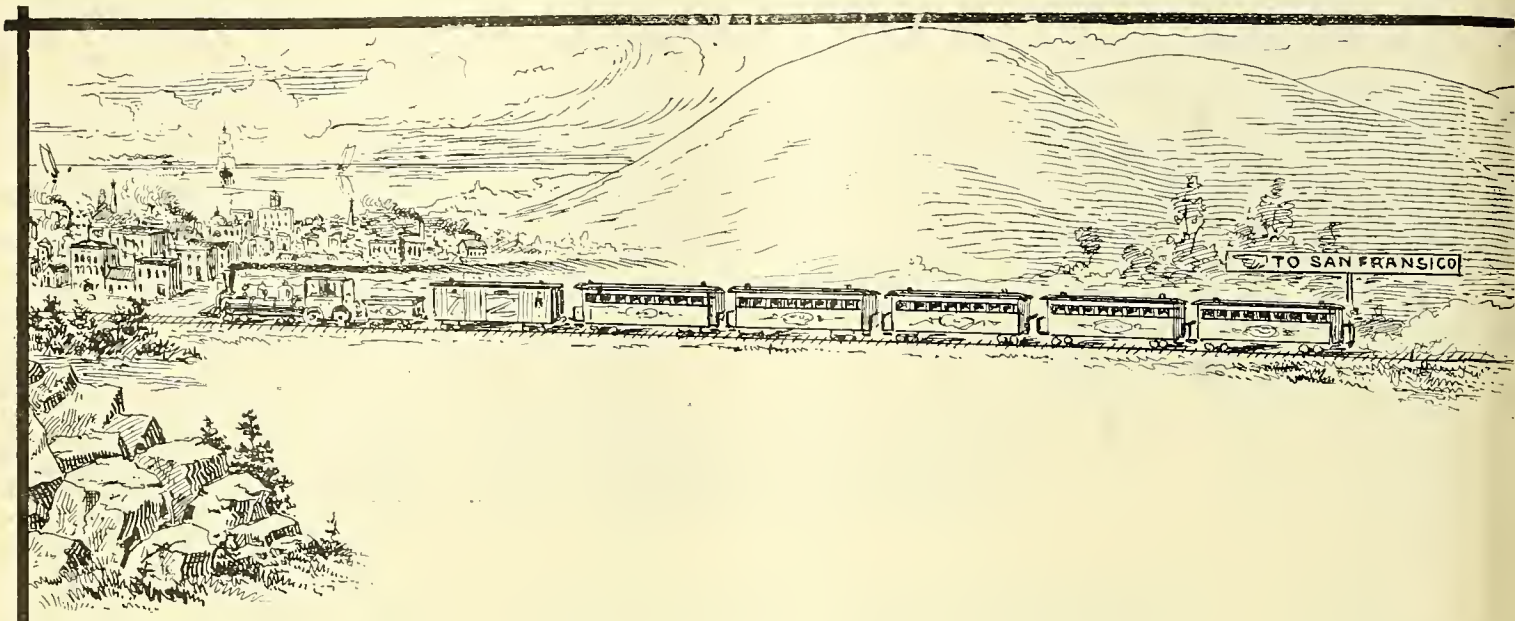

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(COMES HIGH BUT WE MUST HAVE IT!)

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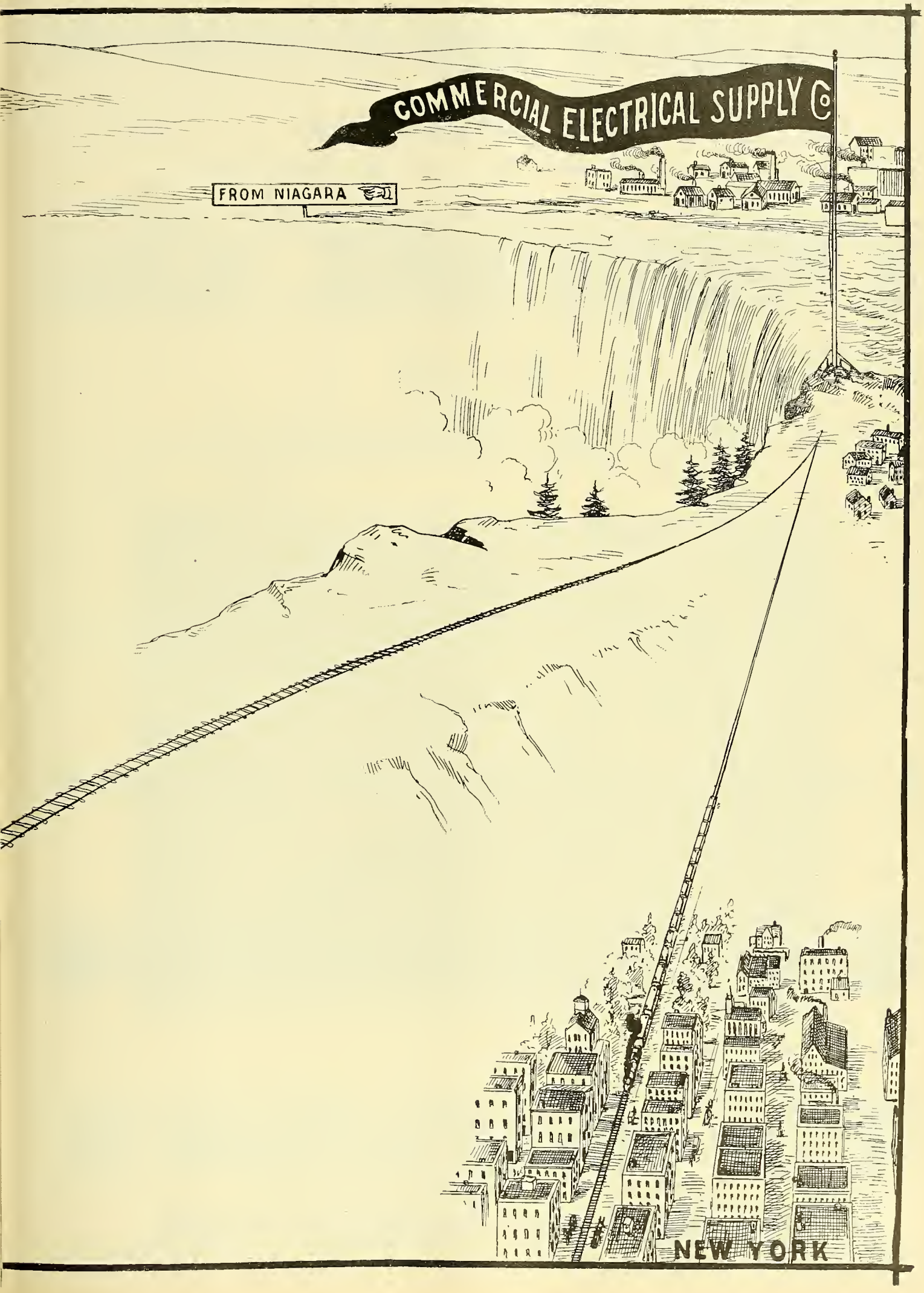
AD STUDIO

ST. LOUIS

NOT DEAD— ONLY "SLEEPING"

H— L! HE ALWAYS DID TALK TOO MUCH— BUT THAT FLAG WAS PLANTED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FROM NIAGARA
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That Series Wound Ammeters stand up better in actual service than those of any other type, and it is also a pretty well known fact that

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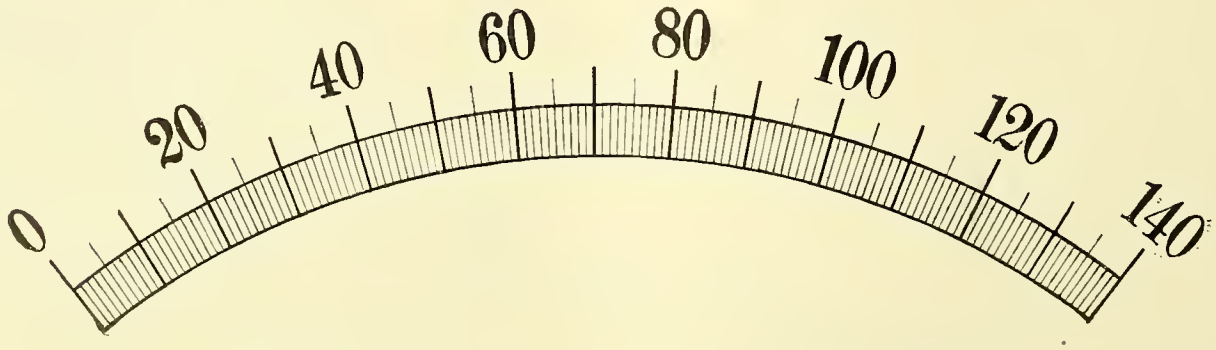


Is only obtained by the use of permanent magnets.

We have recently improved our instruments of this type and now offer an instrument which is strictly dead beat without a mechanical brake.

A combination of these qualities

Is Found Only in Our Standard Station Instruments for Direct Current.

Whitney Electrical Instrument Co.,

PENACOOK, N. H., and SHERBROOKE, QUEBEC.

THE LARGEST STORAGE BATTERY PLANT In the World.

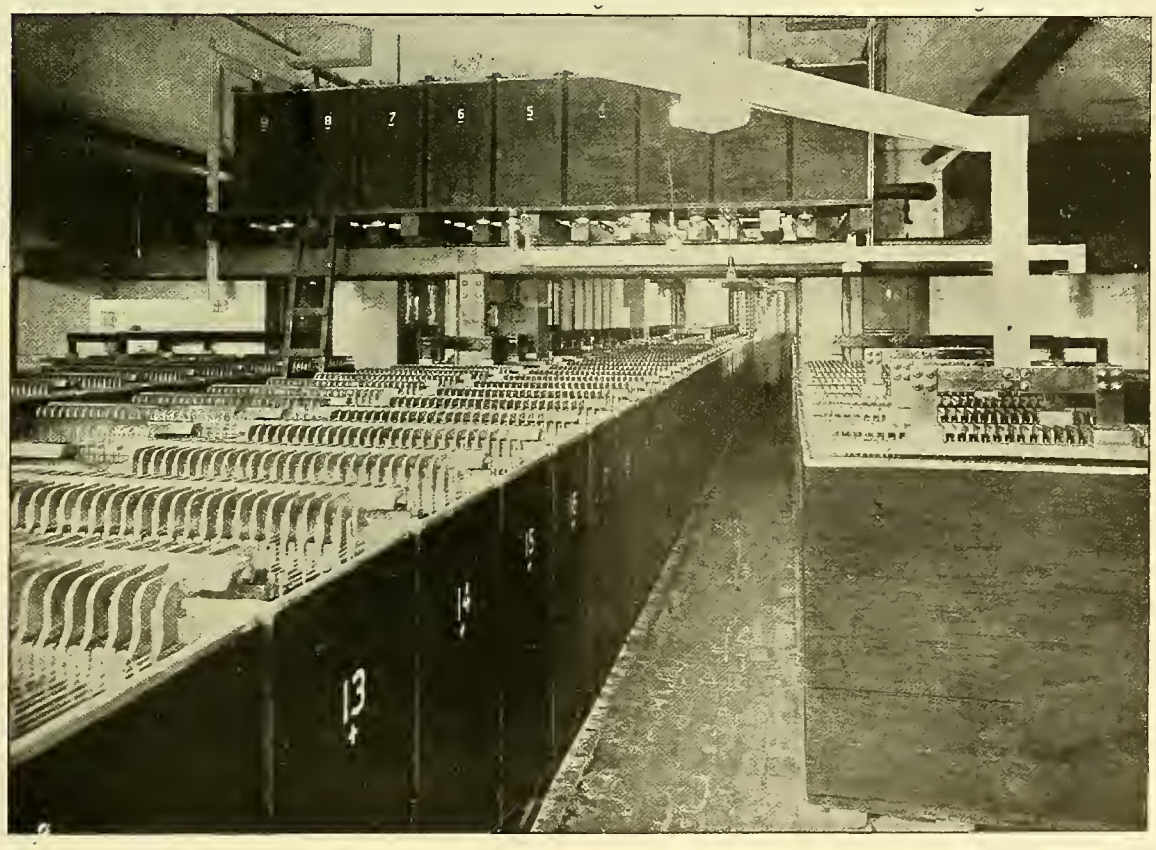
TRADE MARK:
"Chloride Accumulator"
REGISTERED SEPTEMBER 11, 1894.

160 Chloride Accumulators.

CAPACITY 2,500,000 WATT HOURS.

Replacing 2,000 Horse Power in Boilers, Engines and Dynamos.

CARRIES { Peak of the Load.
Entire Load of Station for 6 Hours During the Night.
Entire Sunday Load for 14 Hours.



Installed for the Philadelphia Edison Electric Light Co. by

THE ELECTRIC STORAGE BATTERY CO.,

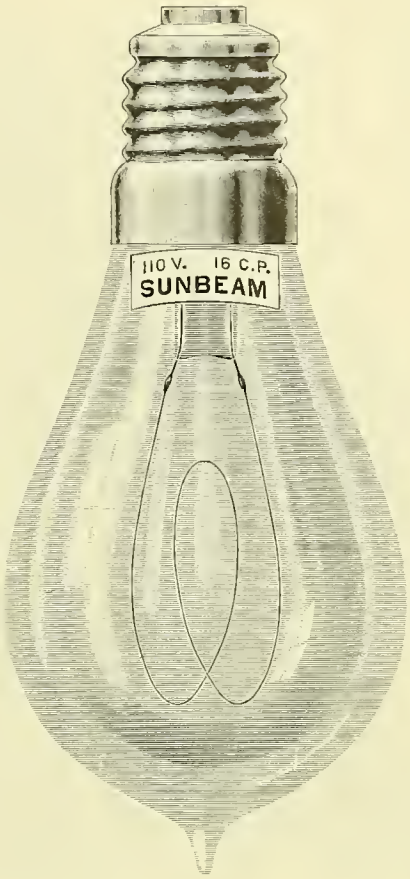
Drexel Building, Philadelphia.

BRANCH OFFICES:

New York, 20-22 Broad St.
Boston, 92 State St.
Chicago, 1543 Marquette Bldg.
San Francisco, 222 Market St.

Western Electric Co.,

New York. Chicago.



"A Thing of Beauty is a Joy Forever"

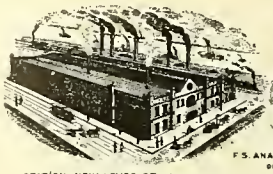
Largest Leather Belt in the World.

MANUFACTURED BY

CHICAGO BELTING COMPANY,

67-69 South Canal Street, CHICAGO, ILL.

GEO. Q WHITNEY & A.S. BADGER, RECEIVERS.



LOUISIANA ELECTRIC LIGHT CO.
ARC AND INCANDESCENT ELECTRIC LIGHTING & POWER.
F.S. ANABLE, GENERAL MANAGER.

STATION. NEW LEVEE ST. BET RICHARD & MARKET STS
OFFICE OF RECEIVERS. 828 GRAVIER ST.
TELEPHONE No 1486

NEW ORLEANS, LA. Dec. 16th, 1896.

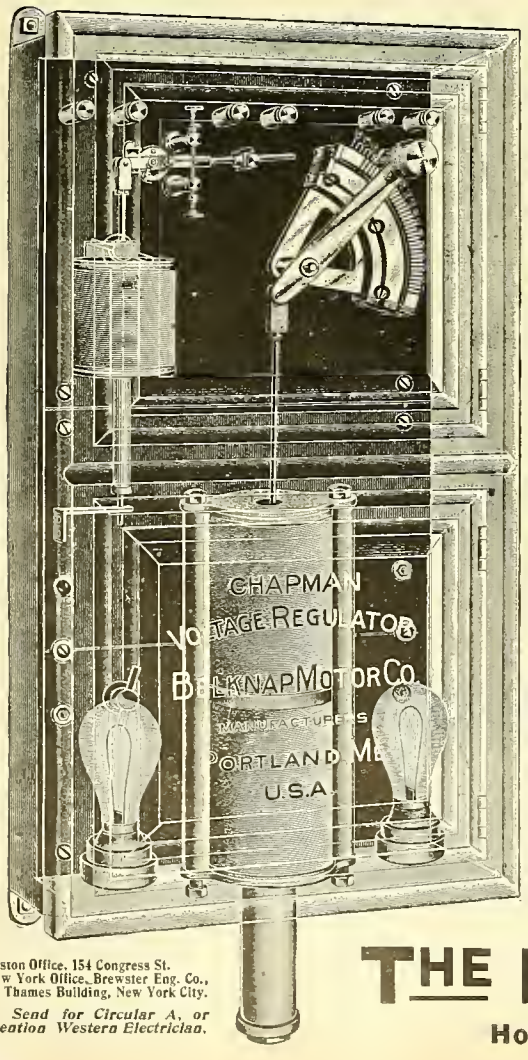
Chicago Belting Co.,
316 & 318 St. Charles St.

Gentlemen:-

In reply to your enquiry regarding the 143 feet of 84 inch wide three ply "Reliance Belt", furnished to us by your Company, we wish to say that it has now been in use for about five months. We have found that this belt is all that you claimed it to be, and since the day it was put on the pulleys, it has never given us a moment's trouble. It runs true and straight, is very even, and has stretched very little, although we have carried with it a load of 1800 horse power. The belt is made without rivets or pegs, depending only on the cement, none of the laps or joints have opened, and the belt is in apparently as good condition as it was the day it was placed upon the pulleys.

Very truly,

WRITE FOR PRICES ON "DYNAMO" BELTING.



Steady Lights from Unsteady Power.

The Chapman Voltage Regulator

Controls the voltage of varying speed dynamos.

Lamp renewals reduced.

Perfect regulation of voltage by an automatic device magnetically controlled. 25 to 50 per cent. variation in speed of water wheel or engine controlled within 2 per cent. of the normal, and it acts as quick as a circuit breaker. Every central station should have them. Generators can be worked nearer the limit of their capacity by their use, thus increasing their effective working power.

Some who are using:

Vermont Electric Light Co., Burlington, Vt.
Glen Mfg. Co., Berlin, N. H.
Rumford Falls Sulphite Co., Rumford Falls, Me.
Northfield Electric Co., Northfield, Vt.
Hollingsworth & Whitney Co., Waterville, Me.
Bar Mills Electric Co., Bar Mills, Me.
Forest Mills Co., Bridgton, Me.
Norway Electric Light Co., Norway, Me.
Crookston Water, Pr. & Lt. Co., Crookston, Minn.
Pondicherry Mills, Bridgton, Me.
Kingston Electric Co., Philadelphia, Pa.
Burgess Sulphite Co., Berlin, N. H.
Cliff Paper Co., Niagara Falls, N. Y.
Westbrook Electric Light Co., Westbrook, Me.
Valleyfield Electric Co., Valleyfield, Quebec.
Orr & Co., Paper Mills, Troy, N. Y.

Recent orders have just been received from Stanley Electric Mfg. Co., Pittsfield, Mass.; Calumet & Hecla Smelting Co., So. Lake Linden, Mich.; Edison Elec. Ill'g Co., Topeka, Kan.; Marietta Elec. Co., Marietta, O., and Westbrook Elec. Lt. & Pr. Co., Westbrook, Me.

CORRESPONDENCE SOLICITED.

Patents owned and controlled exclusively by

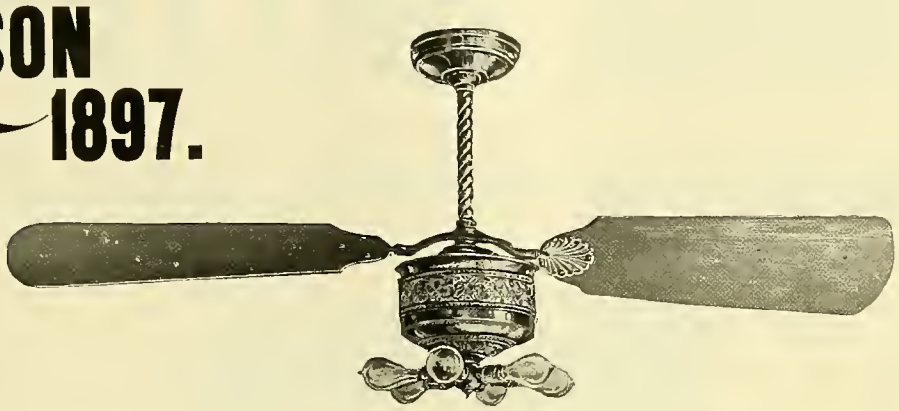
THE BELKNAP MOTOR CO.,

Home Office and Manufactory: Portland, Me., U. S. A.

Boston Office, 154 Congress St.
New York Office, Brewster Eng. Co., Thames Building, New York City.

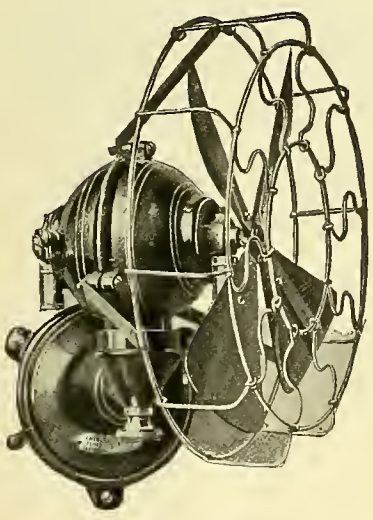
Send for Circular A, or mention Western Electrician.

SEASON 1897.



The LUNDELL FAN MOTORS ARE THE STANDARD

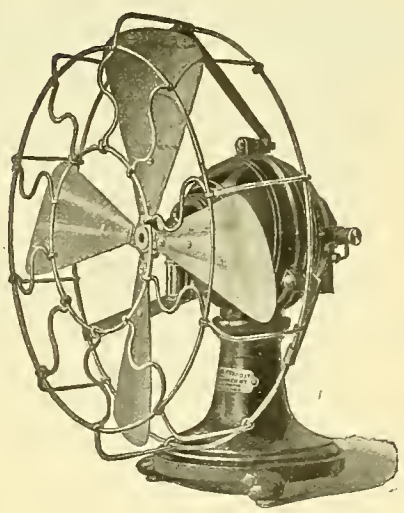
THOUSANDS IN USE



Illustrated Catalogue

. . . UPON . . .

APPLICATION.



Interior Conduit & Insulation Co.,

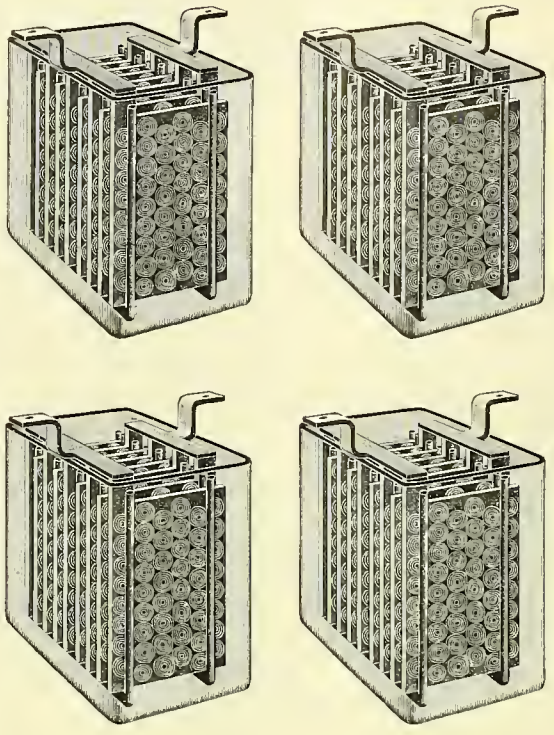
GENERAL OFFICES AND WORKS:

527 W. 34th St., NEW YORK, N. Y.

STORAGE BATTERIES.

New Process, Perfect Insulation, Highest Efficiency.

Non-Infringing.



Protection Guaranteed.

An Electro-Chemically formed SOLID LEAD Plate. NO PASTE, NO PELLETS, NO CEMENT, NO JOINTS.

CANNOT BUCKLE NOR BEND. NO SHORT CIRCUITS IN CELLS. INTERNAL RESISTANCE VERY LOW.

Storage Batteries of any Capacity or Voltage

For Central Station Plants, Isolated Lighting Plants, Incandescent Lamp Testing, Trolley Regulating, Block Signal Service, Electroplating, Propelling Launches, Portable Tools, Ventilating Fans, Elevators, Horseless Vehicles, Telegraph and Telephone Stations, Phonographs, Chemical and Medical Use, X-Rays, Etc.

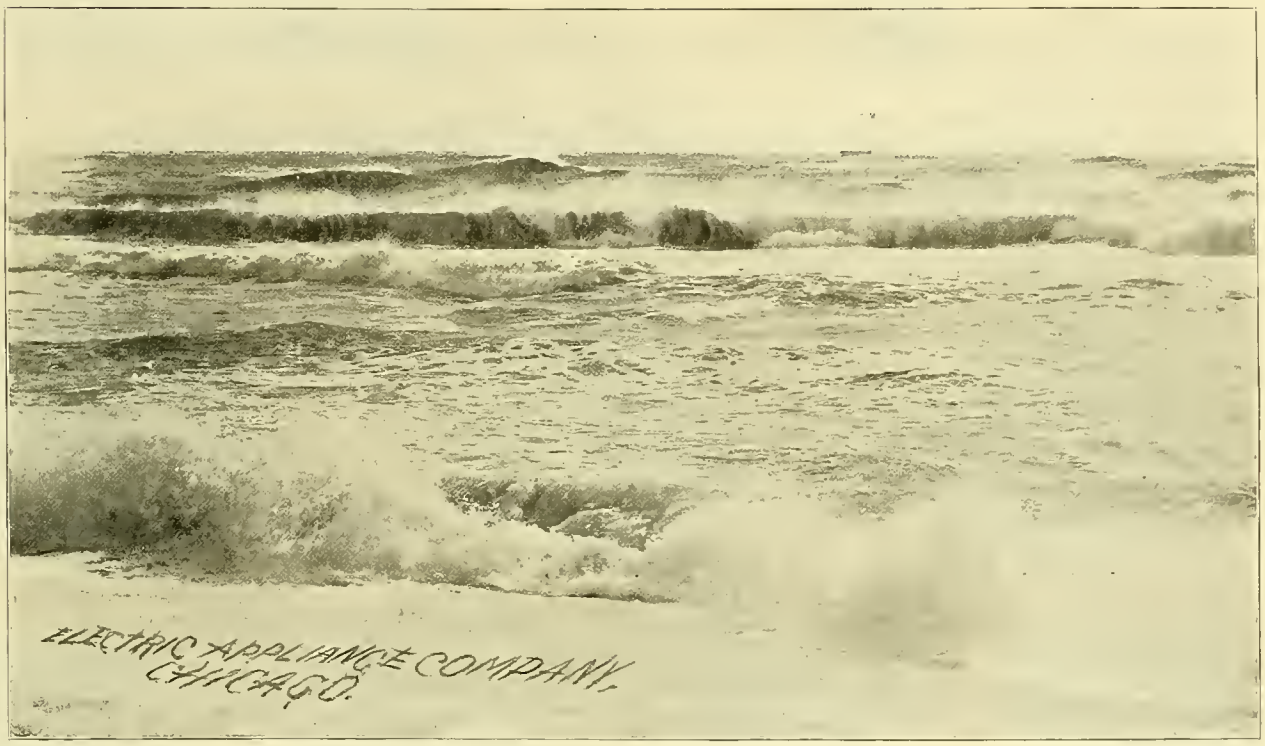
THE OHIO STORAGE BATTERY CO.,

59 Wade Bldg., Cleveland, O.

EASTERN OFFICE,
Machado & Roller, 203 Broadway,
New York.

Agencies in all Large Cities.
Write for Catalogue.

A. W. KILBOURNE,
GENERAL
SALES AGENT.

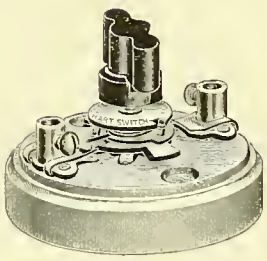


Tides may come;
Tides may go,
With trade ocean's
Ceaseless flow,
But the lash of
Competition's spray
Can never wear this
Name away—
It's been here seven years—
"*It's come to stay!*"

HART S

IMPR

SEND FOR CATALOGUE C.



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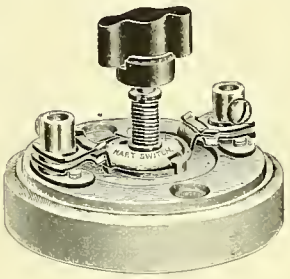

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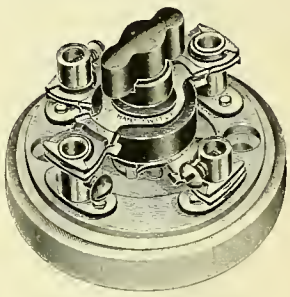

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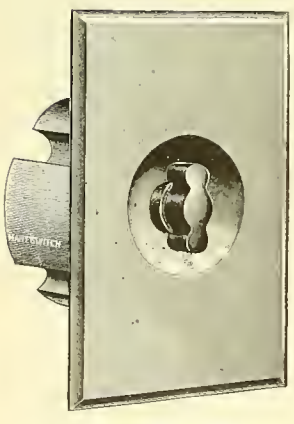
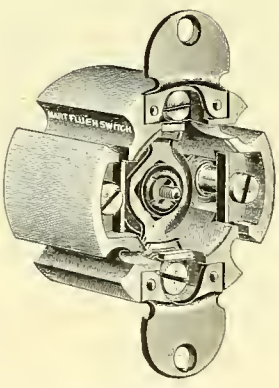


NO. 1 PLATE.



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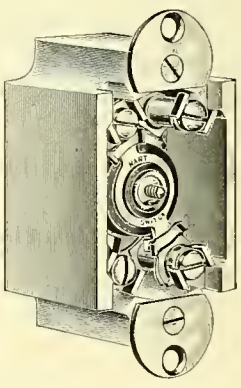

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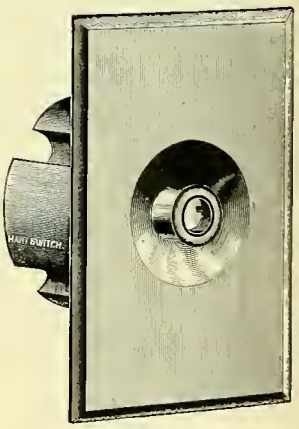


LOCK FLUSH.

"HART SWITCH" is Stamped in the

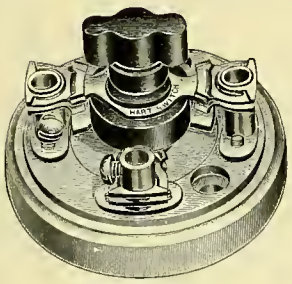
THE HART & HE

Hartford,

witches!

OVED.

SEND FOR CATALOGUE C.



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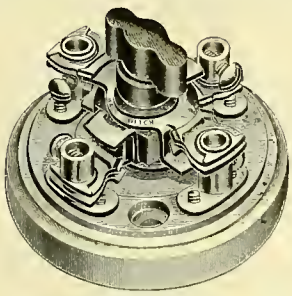

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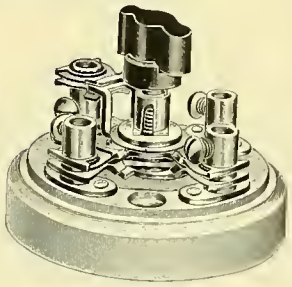

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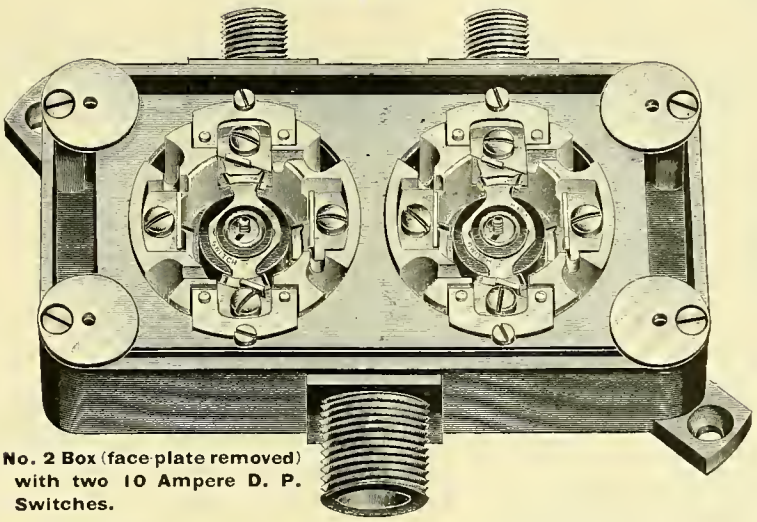


No. 2 Box (face plate removed) with two 10 Ampere D. P. Switches.

Metal of Every Genuine Hart Switch.

GEMAN MFG. CO.,

Conn.

ALCATRAZ ELECTRICAL COMPOUND, INTERIOR CONDUIT TAPE.

MANUFACTURED BY

The California Asphalt Co.,

57 East 59th Street, New York.

Absolutely Unequaled for

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch Boards.

WATER-PROOFING CUT-OUT BOXES, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.

PAINTING POLES, BRACKETS, Cross-Arms, Benches, Floors, etc.

COATING CABLES, Lead-Covered Pipes, and all underground work.

Alcatraz Electrical Compound

Is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. IT WILL NOT SCALE, CRACK OR BURN. PRESENTS A SMOOTH SURFACE. ADHERES TENACIOUSLY. NOT AFFECTED BY THERMAL OR CLIMATIC CONDITIONS. RESISTS THE ACTION OF THE ELEMENTS, ACIDS, ALKALIES, SEWER GASES AND POSSESSES GREAT STRENGTH AND ELASTICITY. Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price.

Sample Upon Application. Agents Wanted in all Leading Cities.

The Standard for Ten Years.

P & B ELECTRICAL COMPOUND.

Tried,
Tested,
Known,
Recommended.

This is a
Guarantee
of
Superiority.

Experiments are Expensive.

P&B

THE STANDARD PAINT CO.,

Manufacturers of P & B Products,

81-83 JOHN STREET, NEW YORK.

In Stock by all Dealers.

P & B Insulating Tape.

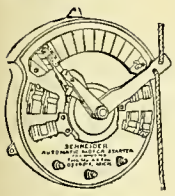
P & B Armature and Field Coil Varnish.

P & B Preservative Paints.

THOS. MUIR & SON,

13 Larned St. W., ... DETROIT, MICH.,

OUR NEW ELEVATOR AUTO-MOTOR STARTER.



110, 220, 500 Volts.

Manufacturers and Selling Agents for

Card Electric Co., Dynamos.
"Lundell" Motors and Fans.
"Imperial" Incandescent Lamps.
Interior Conduit, Brass and Iron.
Insulated Wires.
Insulating Tapes, Etc.
"Detroit" Medical Batteries.

Estimates Given on Elevators.

GET OUR PRICES.

OUR NEW Aluminum-Lined REFLECTORS.

INCANDESCENT AND WELSBACH LIGHTS MADE BRILLIANT.

VULCABESTON Controller and Motor Parts.

Commutator Rings, Brush-Holder Bushings, Controller Parts, Field Magnet Spools, Etc.

Revised prices on TROLLEY LINE INSULATORS, Philadelphia Section Insulators, Insulated Crossings, Etc.

H. W. JOHNS MFG. CO., 240 RANDOLPH ST., CHICAGO.

100 William St., New York. Philadelphia. Boston. London.

ELECTRIC CIGAR LIGHTER AND ADVERTSING DEVICE.

AGENTS WANTED.

In ordering state whether direct or alternating current.

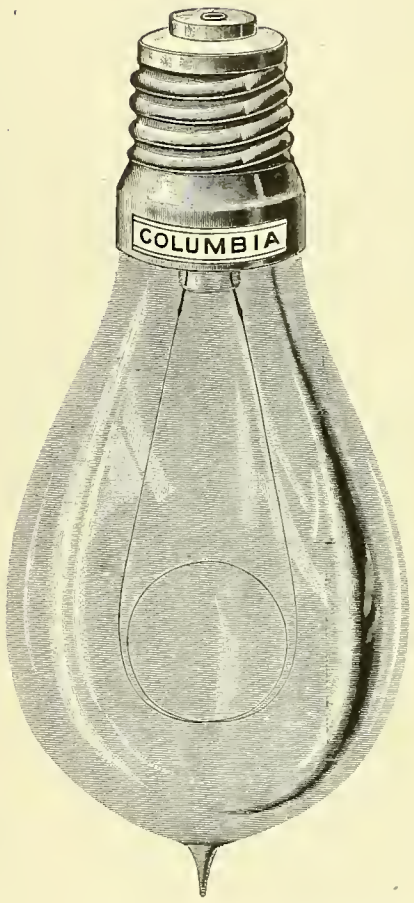
For prices and further particulars address

ELECTRIC CIGAR LIGHTER & ADVERTISING CO.,

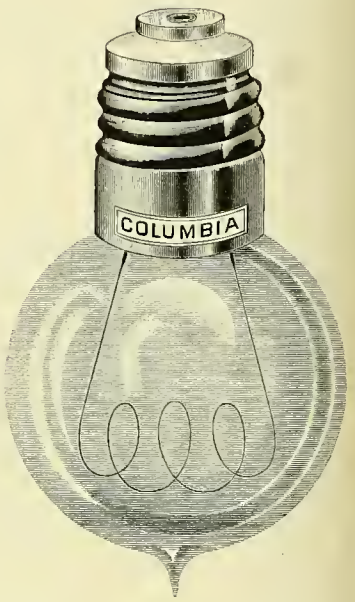
1506 Chemical Building, ST. LOUIS, MO.

COLUMBIA

Incandescent Lamps.



UNEQUALED IN QUALITY.



Before renewing your annual contracts for Incandescent Lamps we request you to make a test of the Columbia. We believe you will find it the most uniform in candle power and in consumption of energy. The candle power is well sustained and the lamps do not grow yellow with age. They furnish the most economical means of transforming electrical energy into light and large savings may be made by their adoption.

We request correspondence with those desiring lamps for immediate requirements or for future delivery. Special prices for annual requirements.

Lamps carried in New York stock for the accommodation of our Eastern trade.

Our prices have never been lower than at present.

The Columbia Incandescent Lamp Co.

MAIN OFFICE AND FACTORY,

1910, 1912, 1914 Olive St., St. Louis, Mo.

BRANCH OFFICES:

Chicago: 1236 Monadnock Building. New York: 711 Havemeyer Building. San Francisco: Paul Seiler Electrical Works.

"THE ELECTRA"

ELECTRA ·TRADE MARK·

HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

The Tuerk Alternating Current Ceiling Fan.

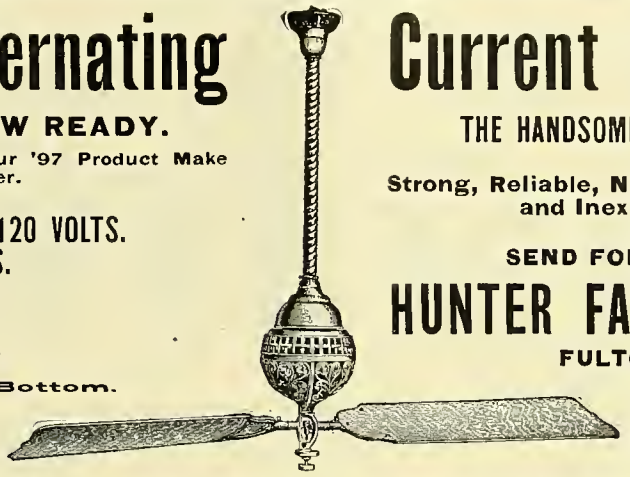
1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.



THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,
FULTON, NEW YORK.

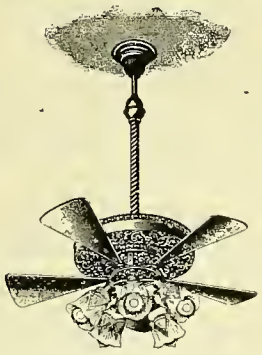
E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

TYPE C. F. 30.

"20TH CENTURY" CEILING FAN.

For High Alternation Systems.

Five Aluminum Blades. Thirty-Inch Sweep. 500 to 600 Revolutions per minute.



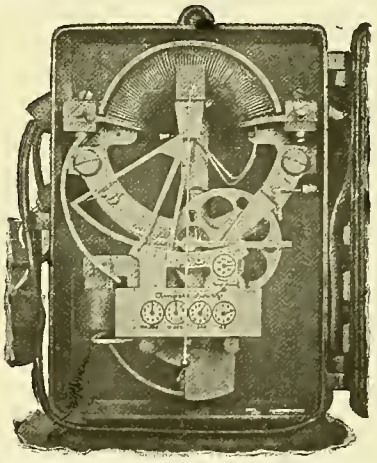
Quiet Running. High Efficiency. Powerful Breeze. Direct Connected.

TYPE C. F. 30.
Current Consumption, 100 Watts.

THE EMERSON ELECTRIC MFG. CO.,
ST. LOUIS, MO., U. S. A.

THE AMERICAN ELECTRIC METER.

Designed for all Forms of Service.



3-Wire 22-Light Meter. Case Open, Showing Mechanism.

The . . . American Electric Meter Co.,

Cor. 9th Street and Montgomery Ave.,

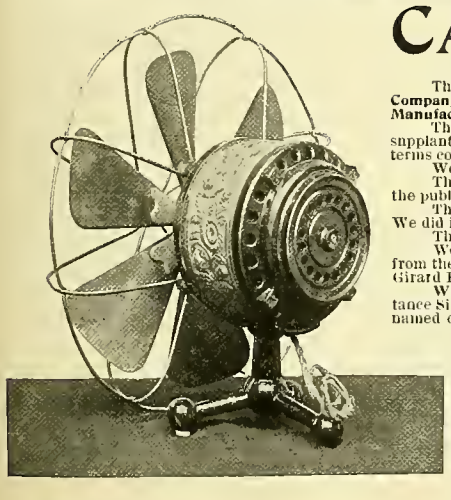
PHILADELPHIA, PA.

Send for circulars and price lists.

HERCULES BATTERIES
LA CLEDE BATTERIES
PERU ELECTRIC MFG. CO. PERU, IND.

PORCELAIN INSULATION Of all Kinds.
We Solicit the making of
SPECIAL DESIGNS OF PORCELAIN.

CARD TO THE PUBLIC.



The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

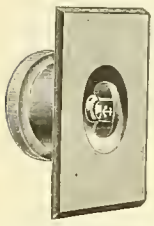
We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.



IT IS EASIER TO MISTAKE OUR RIGHTS THAN TO RIGHT OUR MISTAKES.

It is your right to buy what you please, but you will have no mistakes to right if you make sure of getting ANCHOR SWITCHES. You can tell them by the "Anchor" stamped on the handle.

Anchor Electric Company,

BOSTON. NEW YORK. CHICAGO.

TRANSFORMERS.

SCHEEFFER'S WATT-METERS.

DIAMOND ELECTRIC CO.,

Manufacturers,

Office: 1202 Fisher Bldg., CHICAGO, ILL.

Factory: PEORIA, ILL.

SCHEEFFER'S NEW TRANSFORMER.

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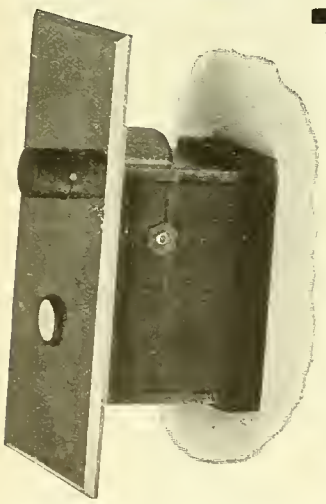

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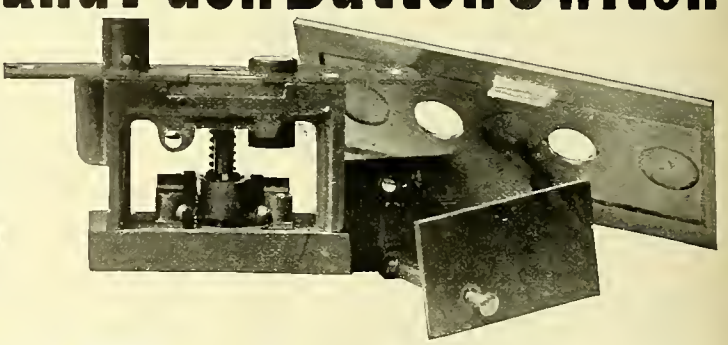

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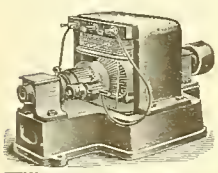

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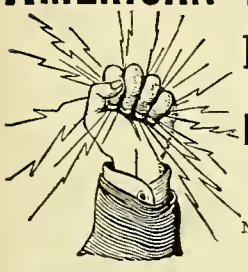

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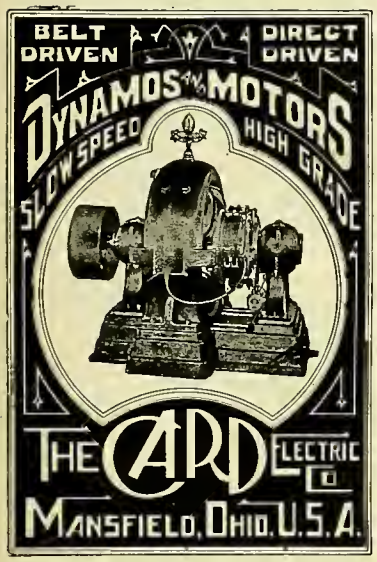

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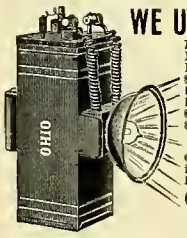

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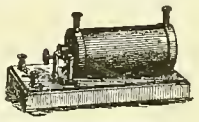

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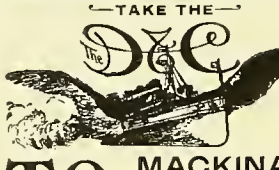

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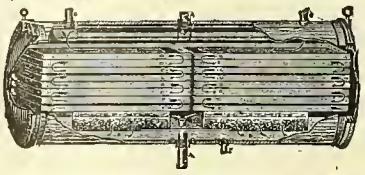

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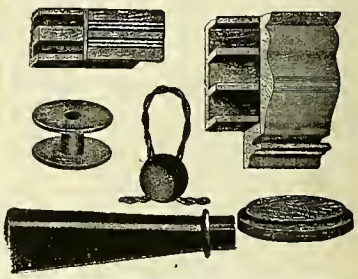

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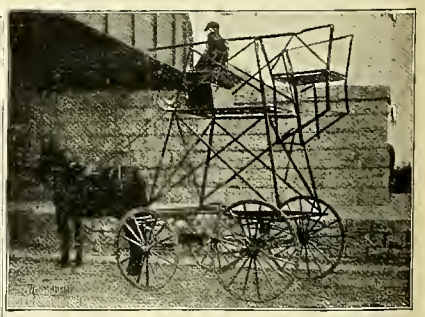

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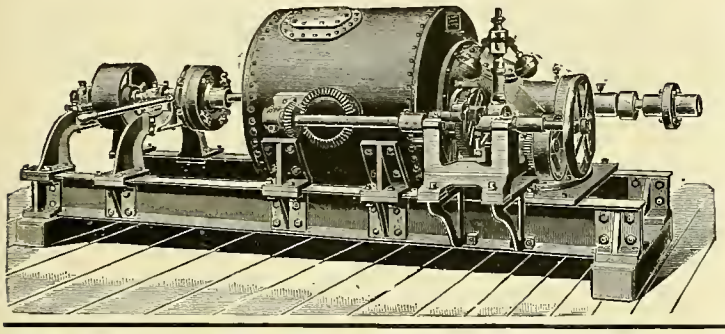

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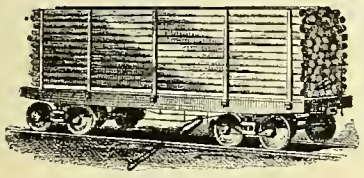

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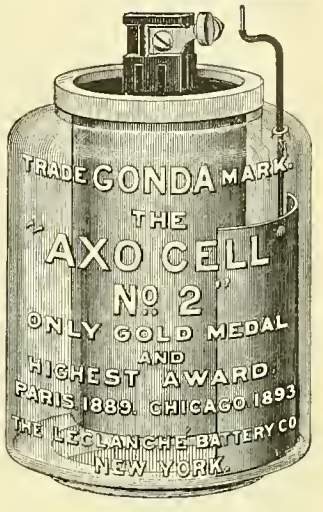

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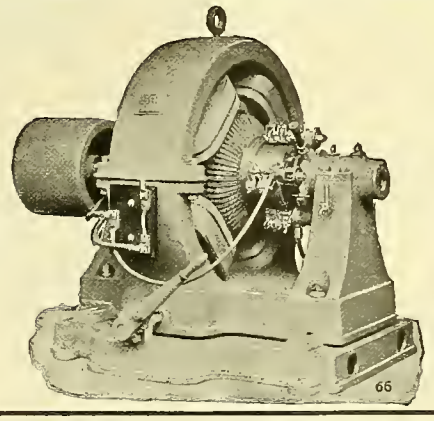

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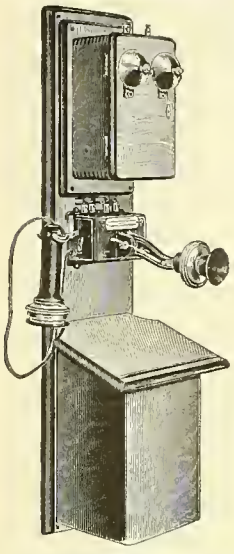

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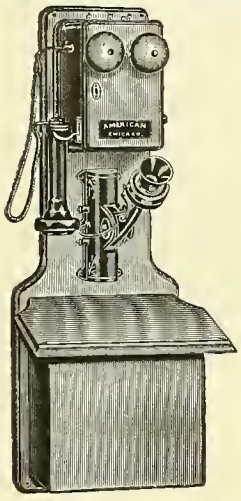

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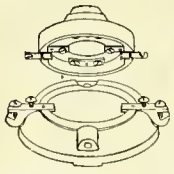

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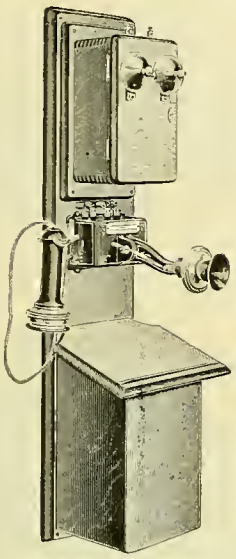

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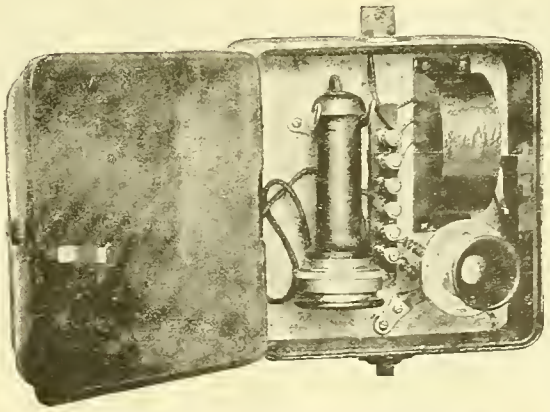

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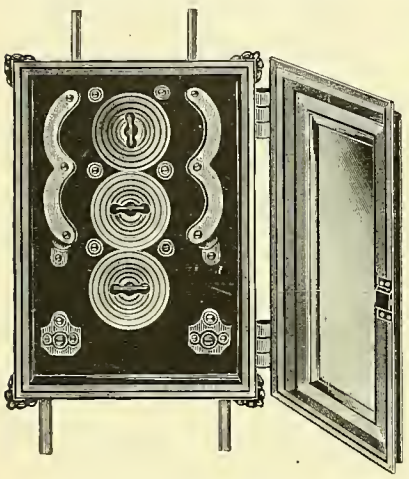

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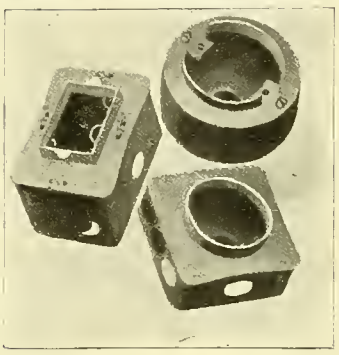

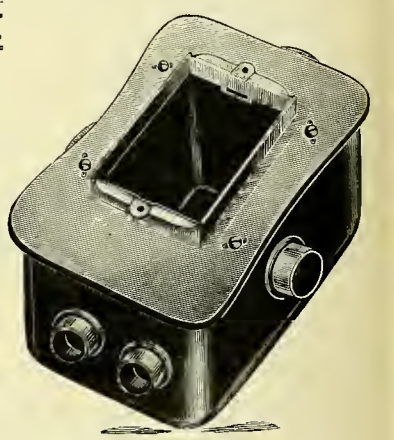

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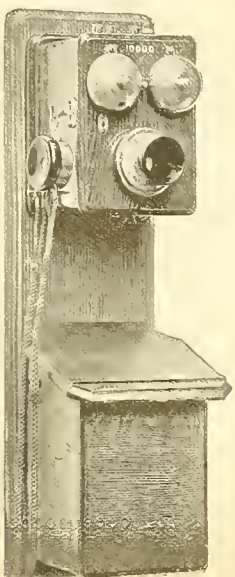

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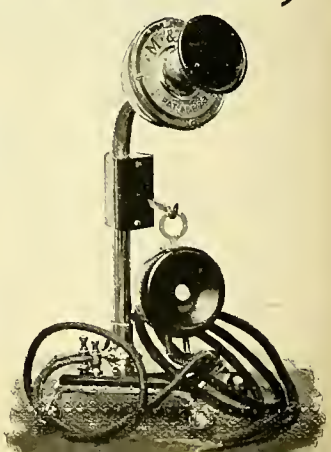

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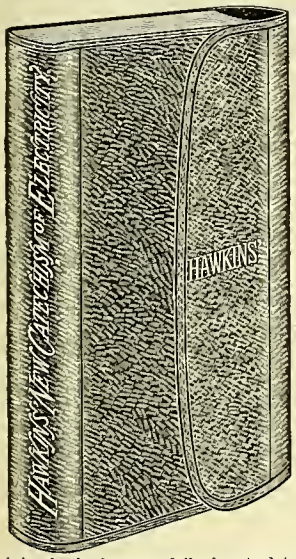

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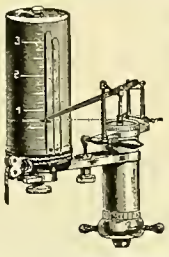

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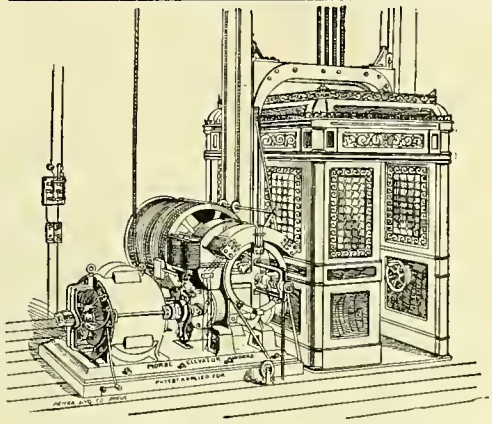

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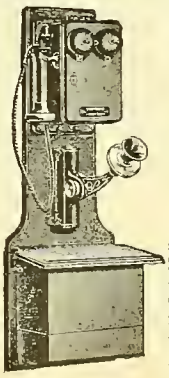

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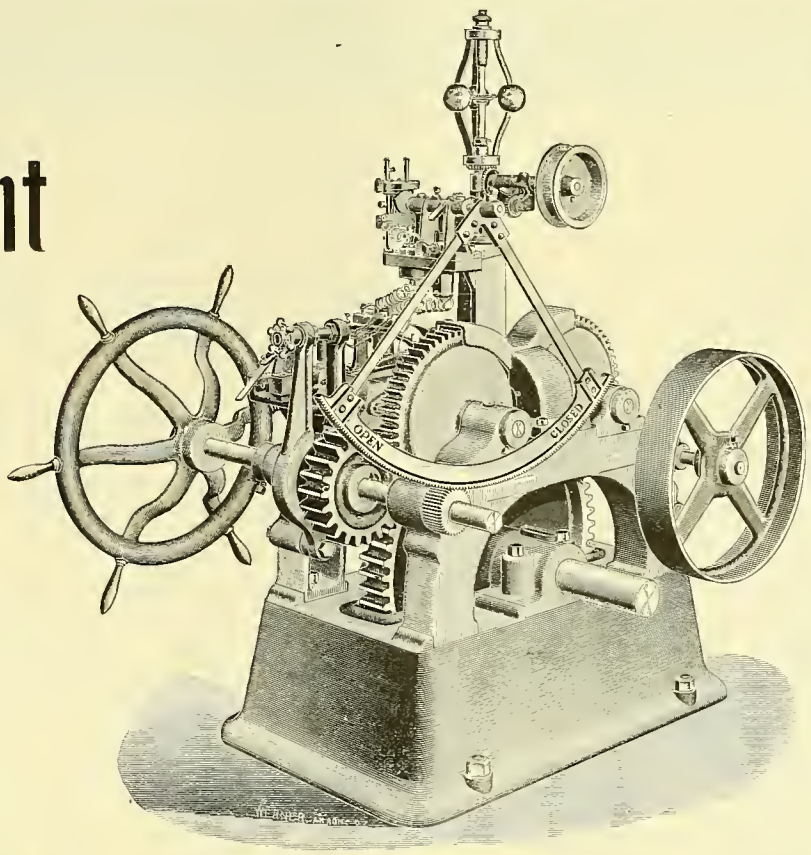

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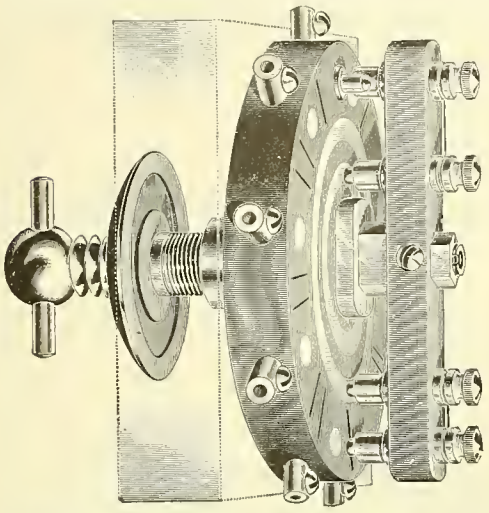

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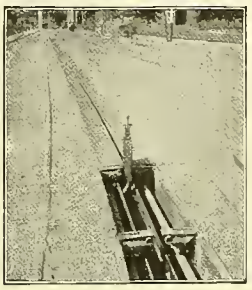

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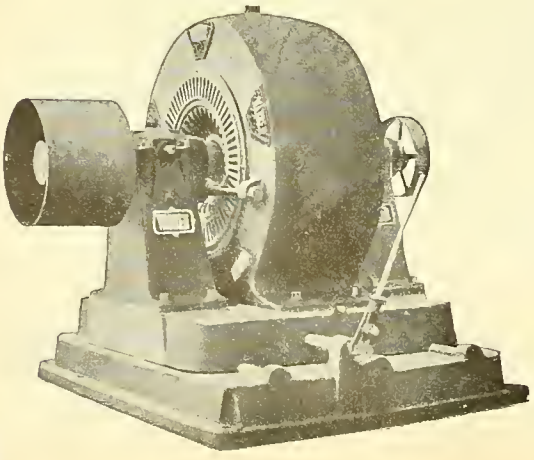

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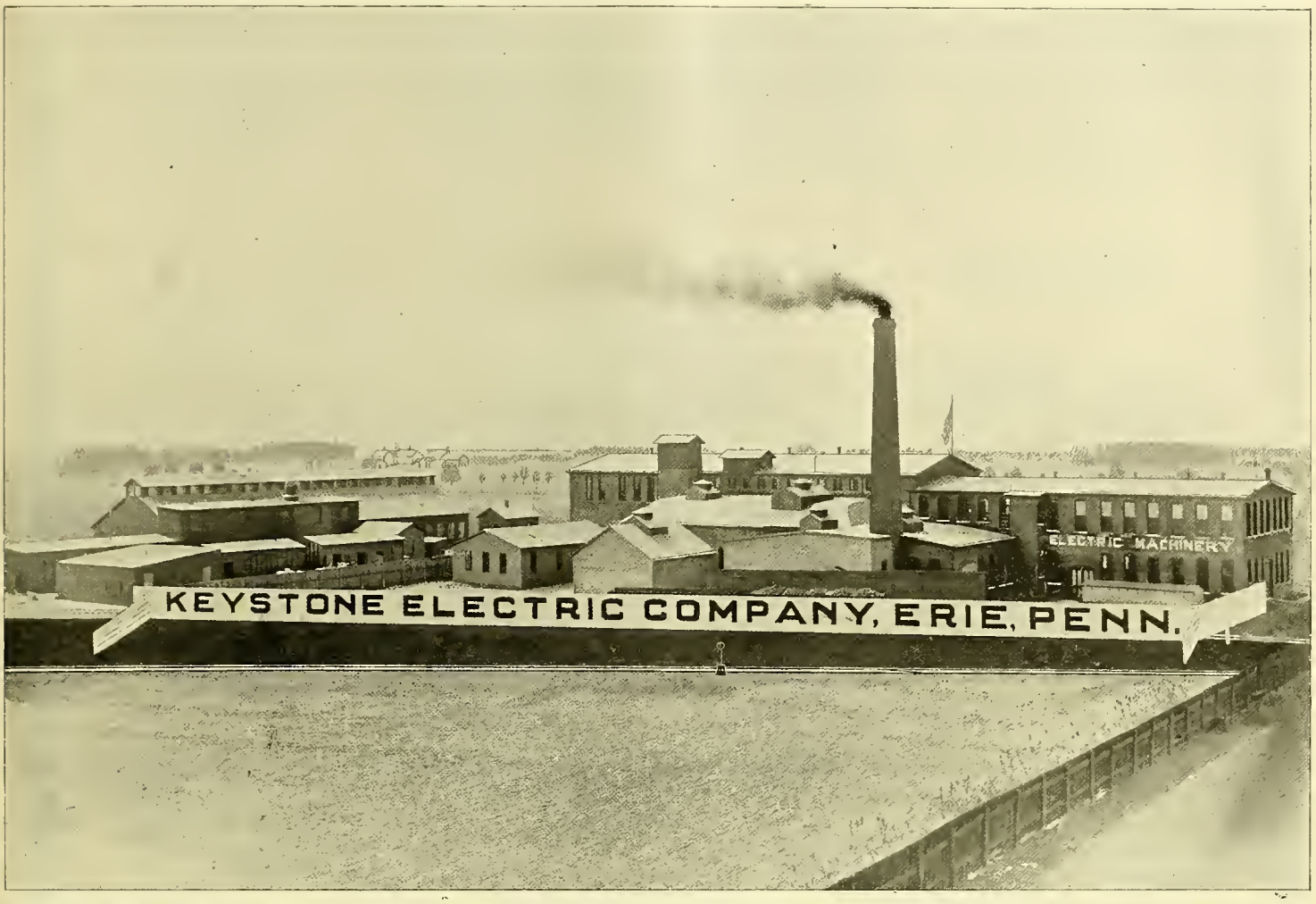

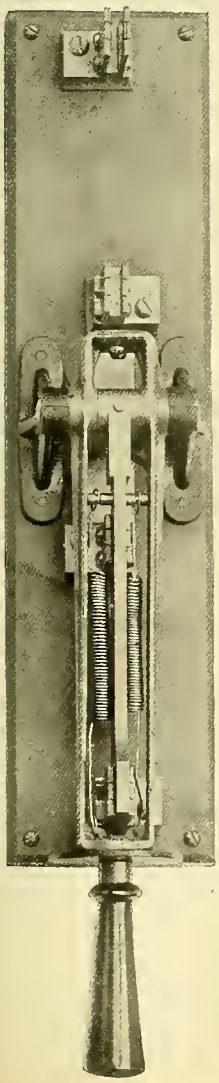

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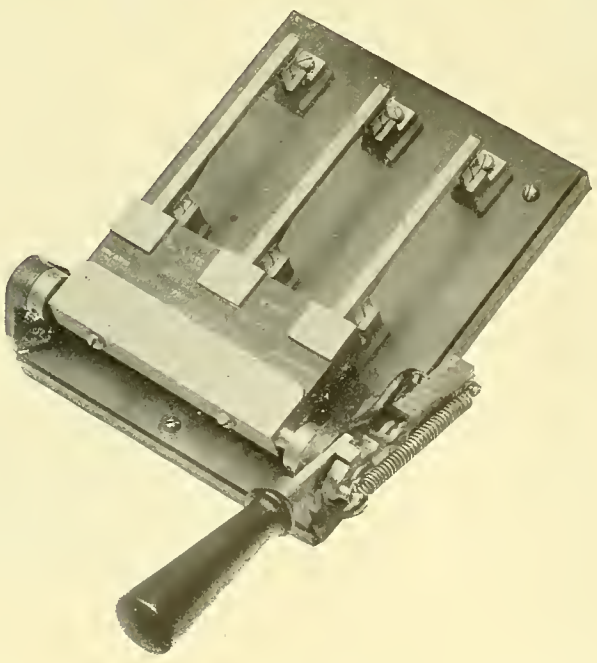

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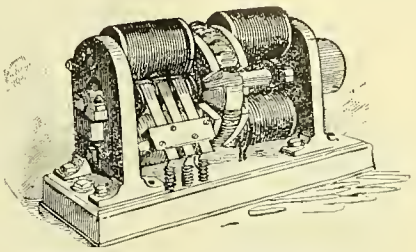

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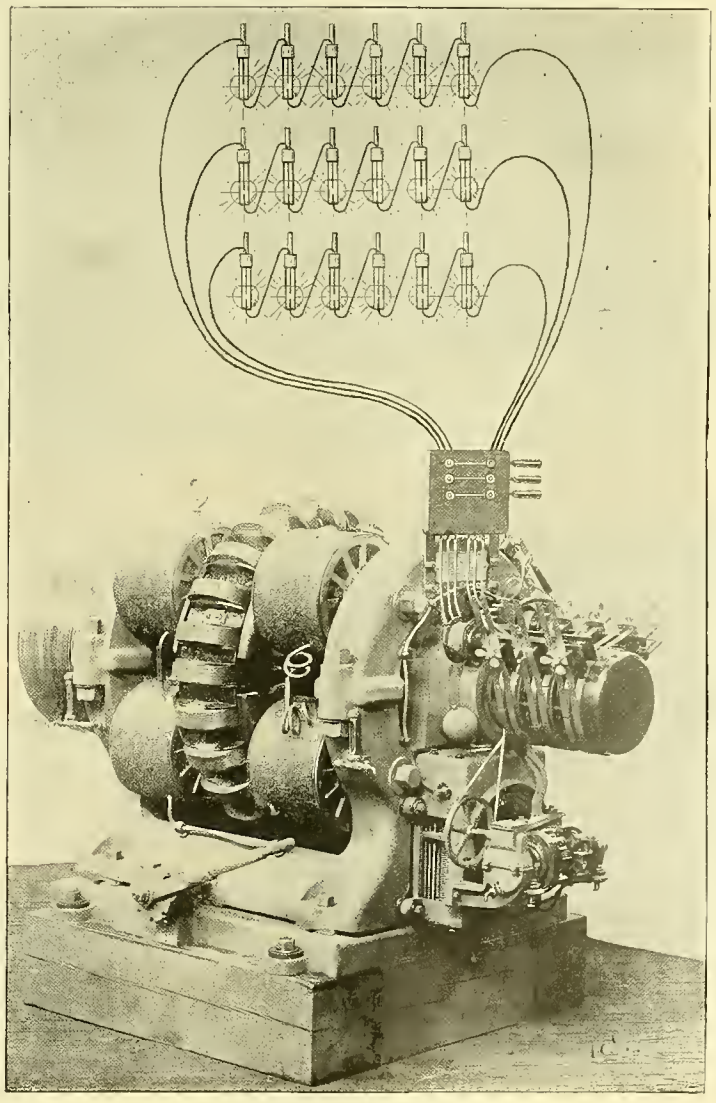

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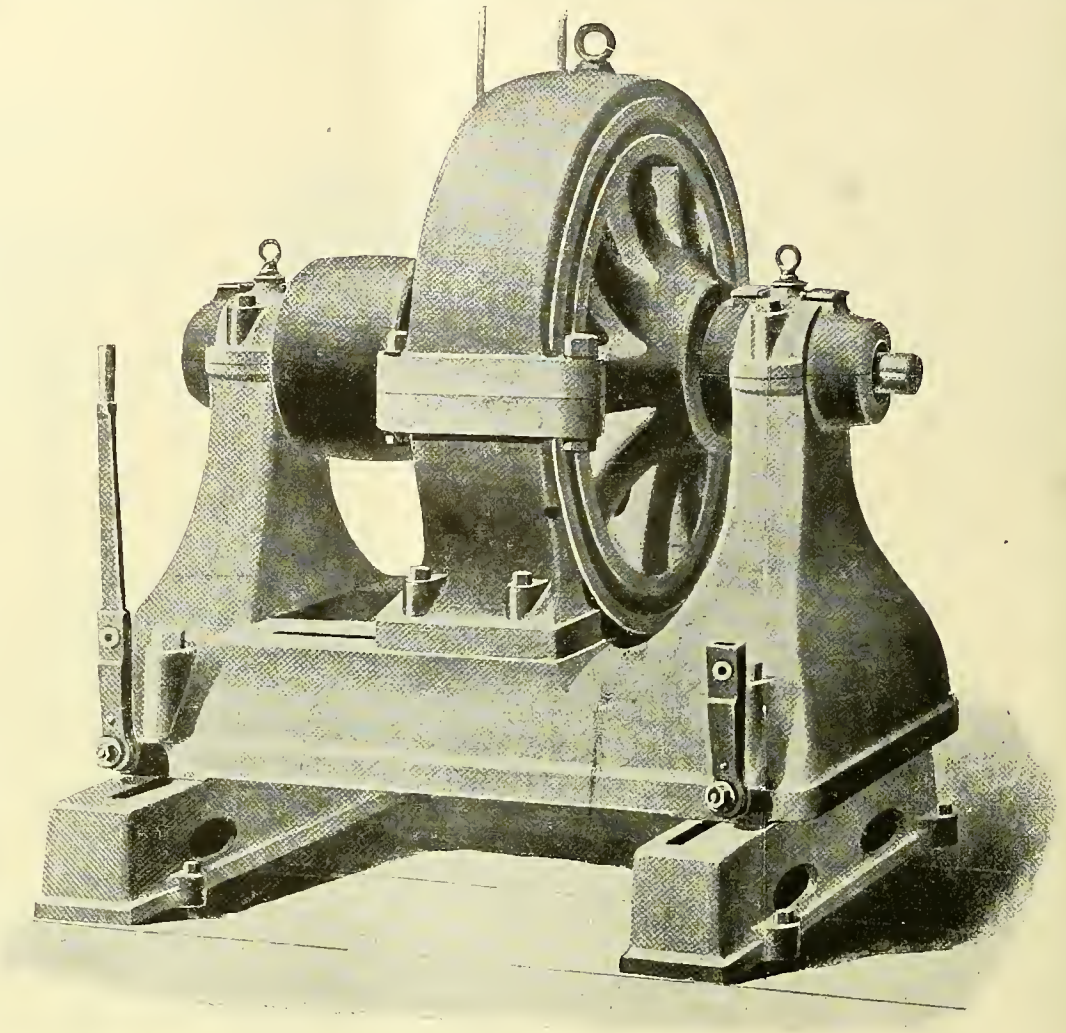

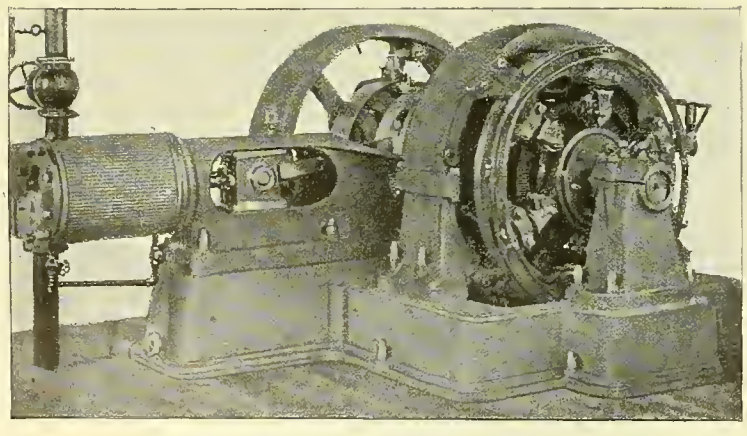

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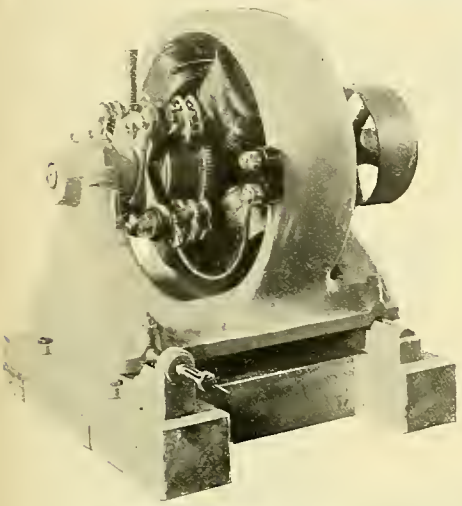

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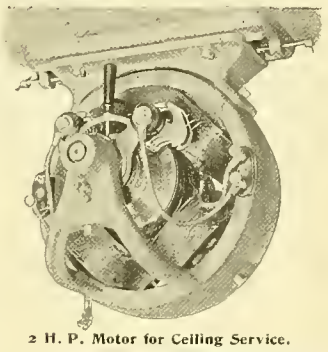

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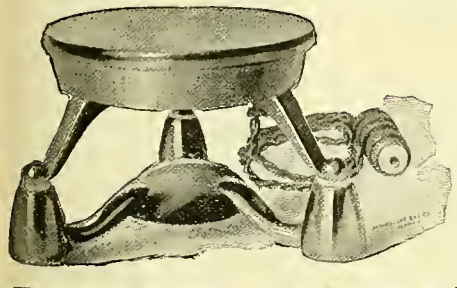

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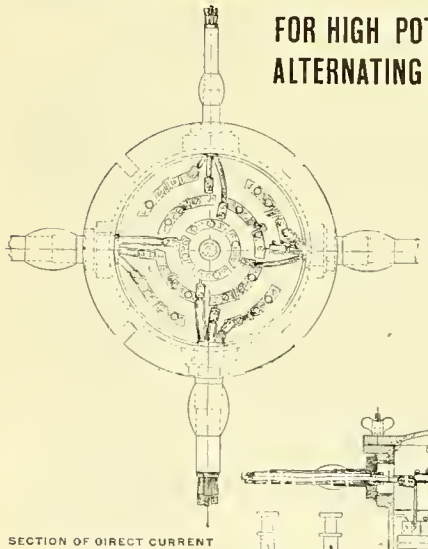

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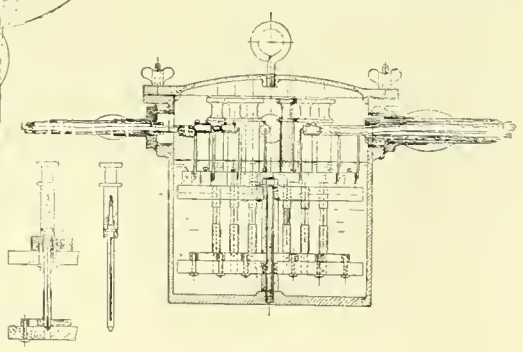

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YOU... remove and replace the lamp without taking guard from the socket.
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THEY require no shade holder to hold guard in place.
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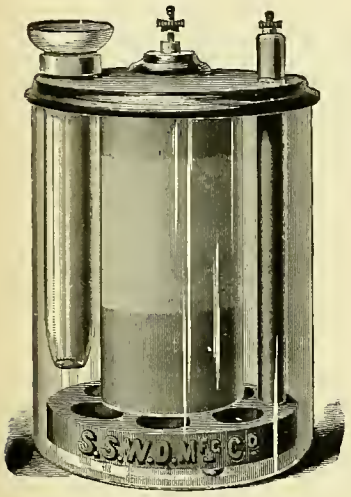

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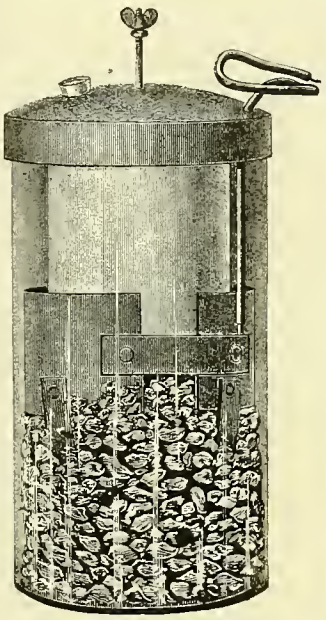

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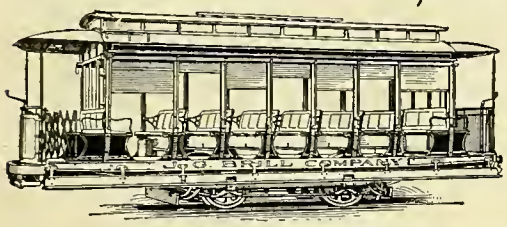

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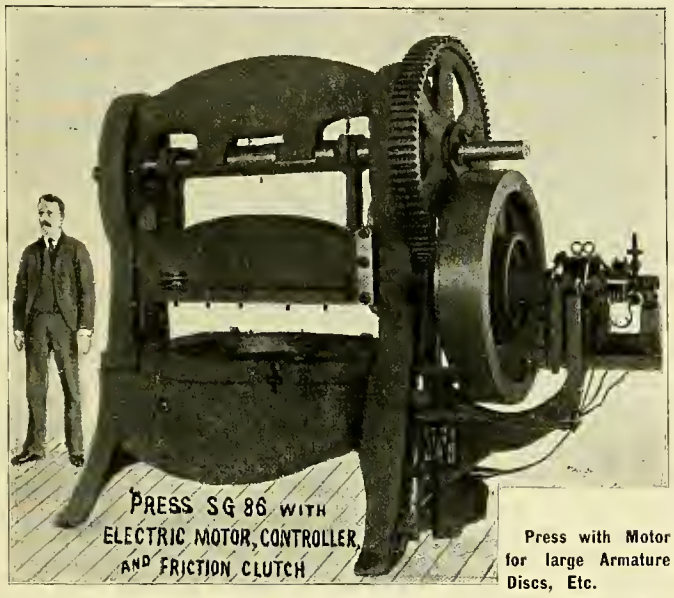

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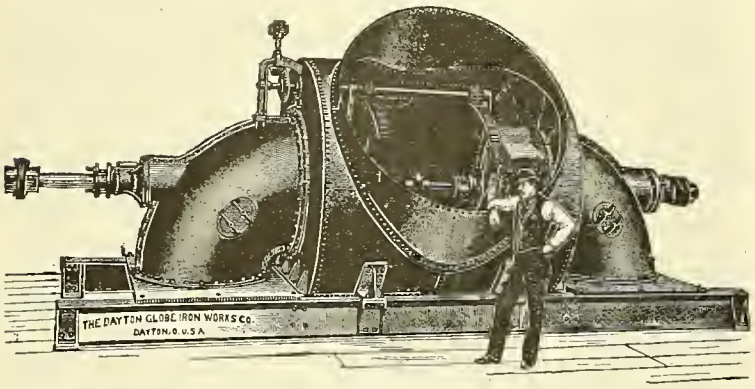

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¾ "	16.78	117.33	112.60	175.74	82.18
⅝ "	17.03	111.83	98.12	149.99	79.31
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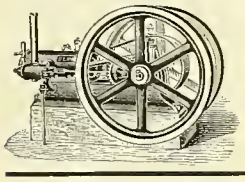

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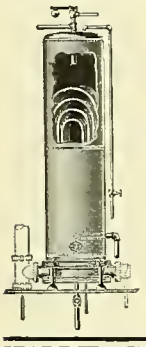

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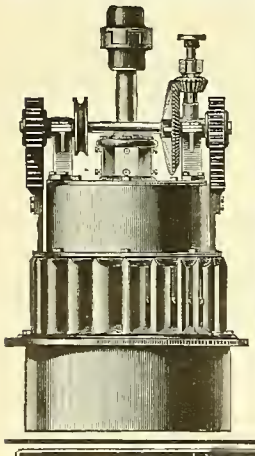

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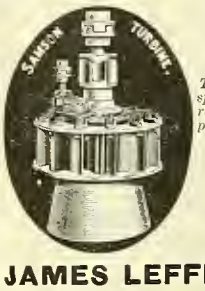

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Test of a 45 in. SAMSON, Jan. 25, '97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03
⅞	15.04	138.12	155.03	223.61	84.55
¾	15.11	127.67	133.24	191.06	83.68
⅝	15.88	131.50	112.85	162.80	80.25
½	16.47	126.87	90.04	127.73	75.95

Test of a 35 inch SAMSON, Feb. 1, '97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.20	194.25	102.02	143.44	81.08
⅞	16.56	187.75	92.15	146.73	84.78
¾	17.33	178.50	83.95	138.40	83.88
⅝	17.54	176.40	68.82	109.64	80.09
½	17.68	168.50	57.69	88.14	76.19

JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

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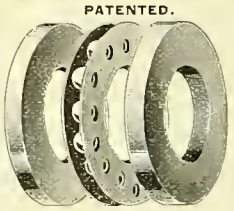

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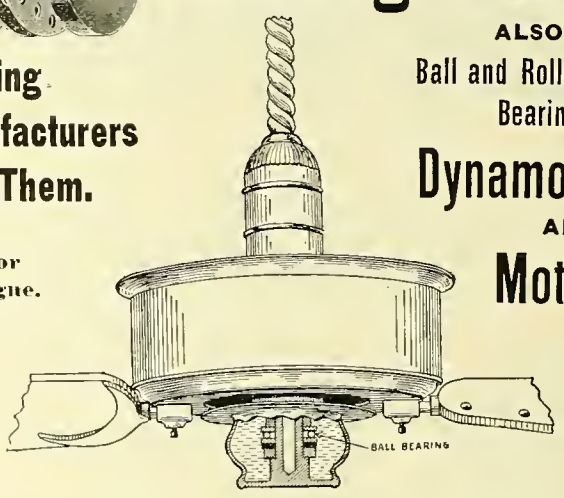

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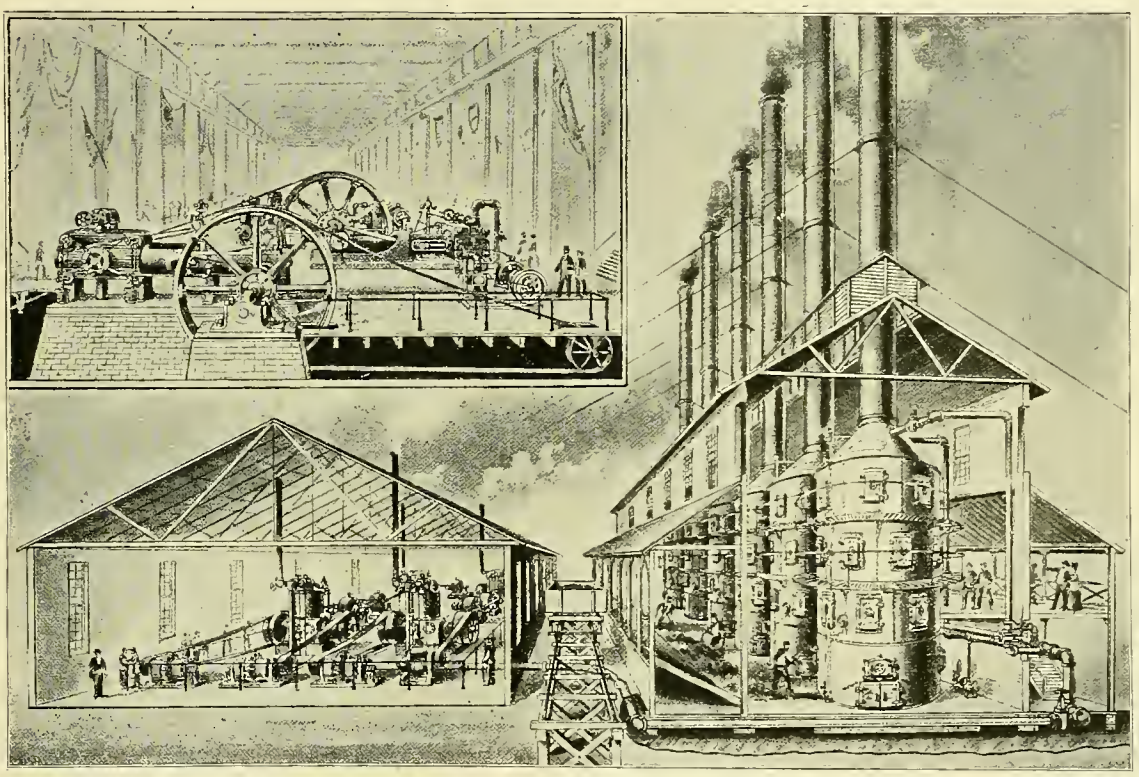

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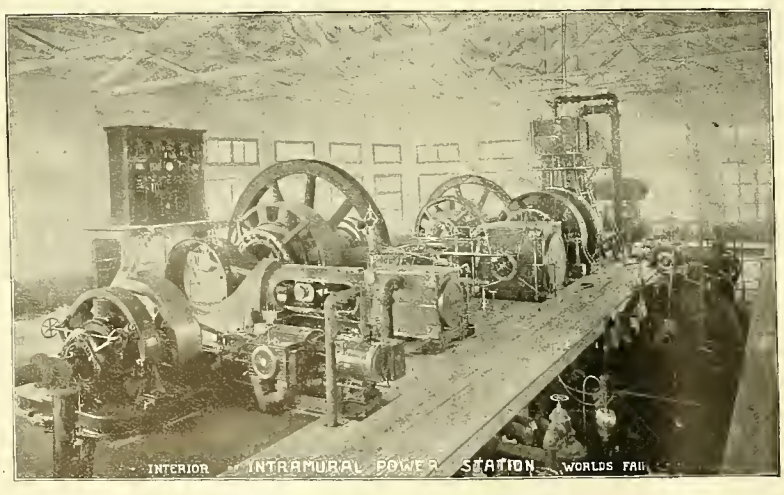

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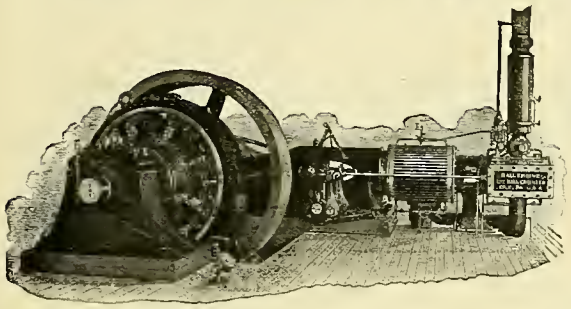

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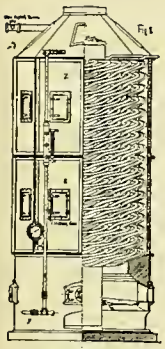

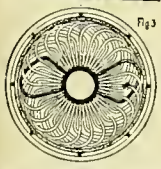

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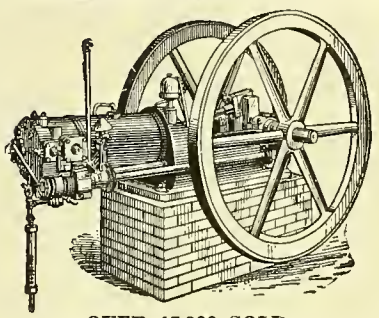

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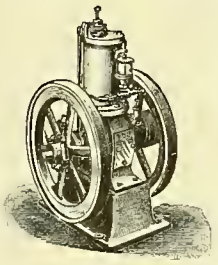

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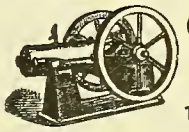

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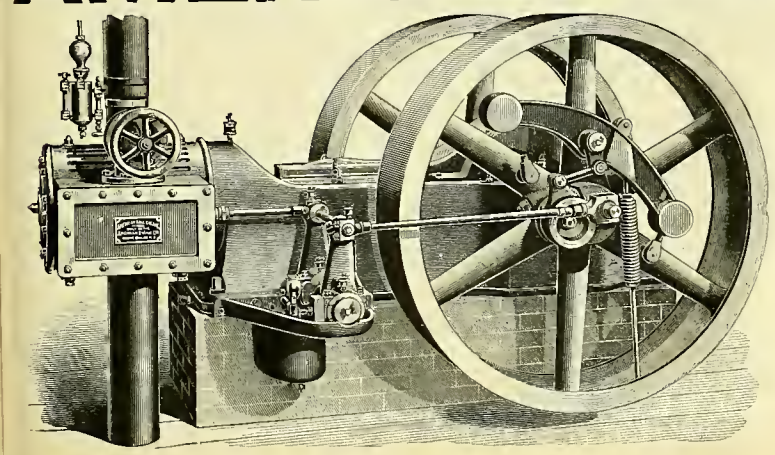

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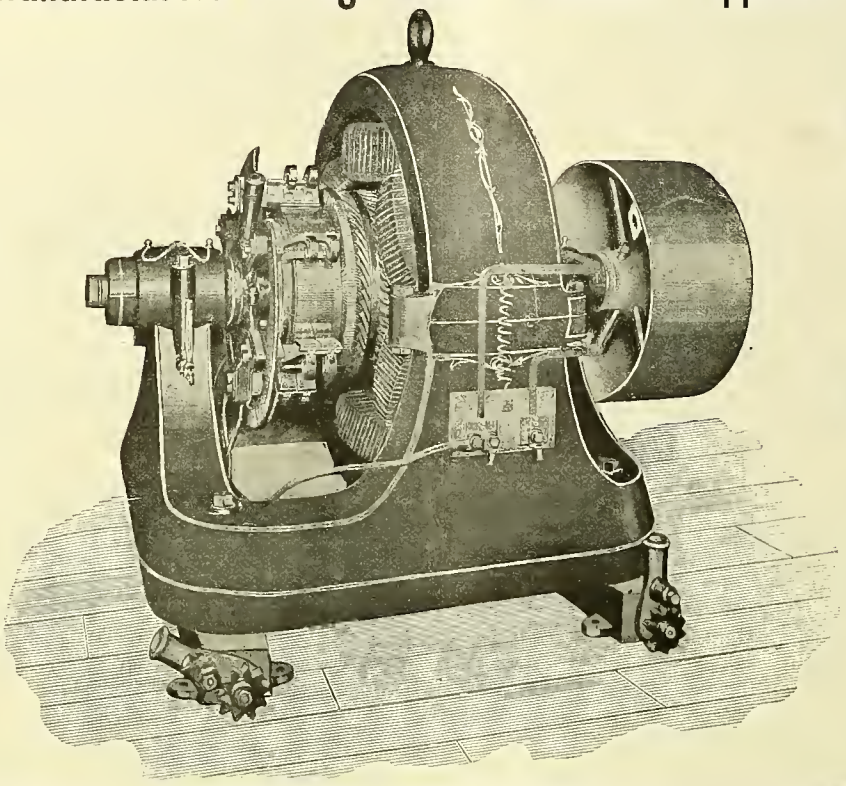

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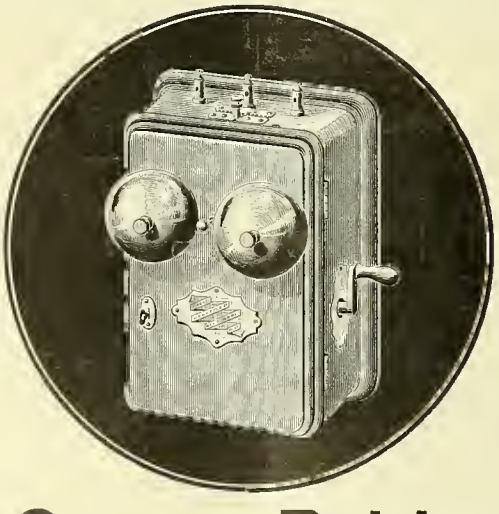

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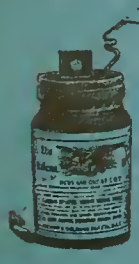

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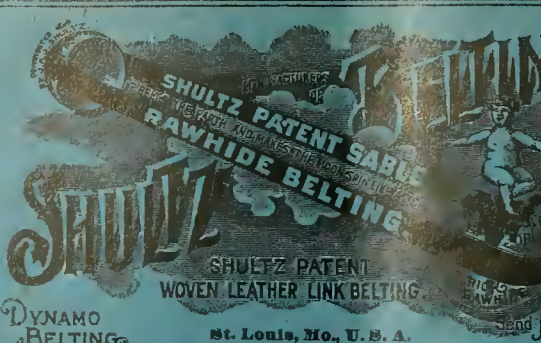

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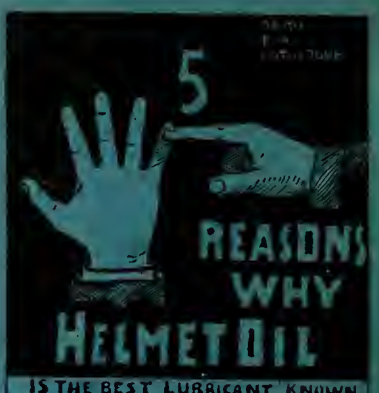

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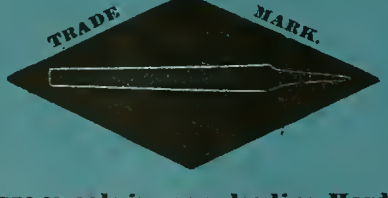

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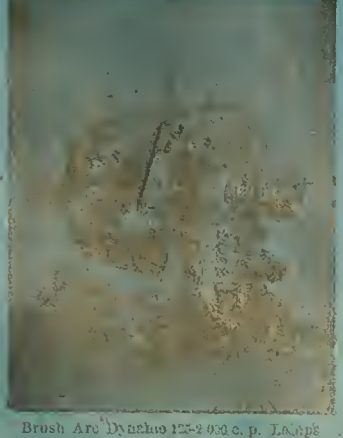

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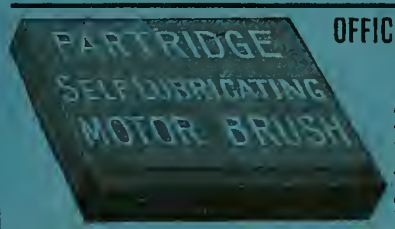

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Direct Connected or Belted for Electric Railways, Central Stations, Isolated Lighting or Power Plants.

Eddy Motors—Slow, Medium or High Speed.

We build all necessary apparatus for the transmission of Electrical Power through factory or other buildings.

The Eddy Electric Mfg. Co.,

WINDSOR, CONN.

NEW YORK, H. B. Coho & Co., Mail and Express Building.
PHILADELPHIA, Walter C. McIntire & Co., 506 Commerce St.
BOSTON, G. M. Angier & Co., 64 Federal St.
ELMIRA, S. N. Blake.
ST. LOUIS, Western Electrical Supply Co.
KANSAS CITY, W. T. Osborn.
CINCINNATI, O., Nevada Bldg., John A. Stewart.
CHICAGO, 305 Dearborn St., Wallace & Hine, Managers.
SAN FRANCISCO, CAL., Cal. Elec. Wks., 409 Market St.

THE CALIFORNIA ASPHALT CO OF NEW YORK — ALCATRAZ A.E.C. ELECTRICAL COMPOUND

Alcatraz Electrical Compound,

Manufactured by

THE CALIFORNIA ASPHALT CO., 57 East 59th St., NEW YORK.

ABSOLUTELY UNEQUALED FOR

ELECTRICAL AND WIRE INSULATION, Insulating Connections, Dynamos and Motor Bases, Battery and Accumulator Shelving, Circuit and Switch-Boards.
WATER-PROOFING Cut-Out Boxes, coating wires when subjected to acid or alkaline fumes, and when laid under cement, etc.
PAINTING Poles, Brackets, Cross-Arms, Benches, Floors, etc.
COATING CABLES, Lead-Covered Pipes, and all underground work.

ALCATRAZ ELECTRICAL COMPOUND is manufactured of the celebrated brand of Alcatraz Asphalt, and possesses many well-known points of superiority. It has been tried under severe and exacting conditions, and has given perfect satisfaction. **It will not Scale, Crack or Burn. Presents a Smooth Surface. Adheres Tenaciously. Not affected by Thermal or Climatic Conditions. Resists the action of the Elements, Acids, Alkalies, Sewer Gases, and possesses great strength and elasticity.** Being the producers of the raw product, we are enabled to save the middleman's profit, and offer consumers a superior article at a very low price. **SAMPLE UPON APPLICATION. Agents wanted in all leading cities.**

NON-ARCING AUTOMATIC CIRCUIT BREAKERS

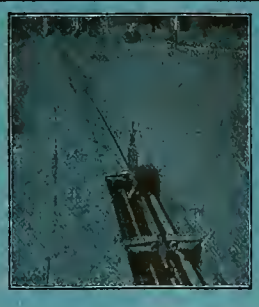
GUARANTEED TO OPERATE PERFECTLY OR NO PAY. MADE FOR ALTERNATING OR DIRECT CURRENT. ANY VOLTAGE. CATALOGUE FREE.

AUTOMATIC CIRCUIT BREAKER COMPANY, NEWAYGO, MICHIGAN, U. S. A.

THE K. A. K. CONDUIT SYSTEM.

Simple in Construction.

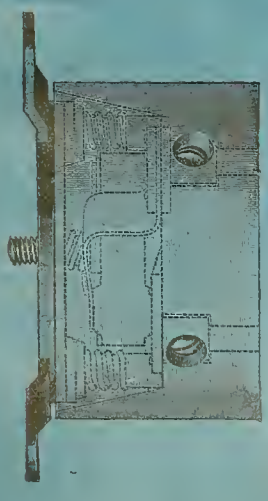
Successfully Stood the Severe Tests of Last Winter's Snowstorms.



Practical in Operation.

SEND FOR FULL PARTICULARS.

KROTZ, ALLEN & KELLY, SPRINGFIELD, OHIO.



IN A PORCELAIN CUP.

This is One Way of Putting Up

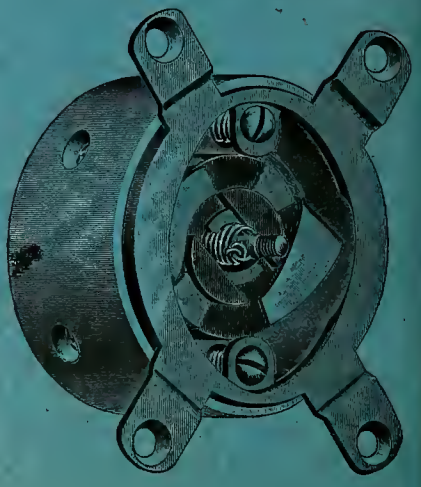
PERKINS FLUSH SWITCHES

AND NO EXTRA COST.

All Parts of Switch Insulated. Solid Adjustable Plates Any Size You Want.

PERKINS ELECTRIC SWITCH MFG. CO.,

New York. Hartford, Conn. Chicago.



The "Pioneer" Secures You Safety.

You avoid the rocks of litigation by placing your orders with the owners of the broad basic patents of Enclosed Arc Lighting; also you get *safety* from falling sparks by our method. The "Pioneer" gives the best light, soft, steady, simple and saving.

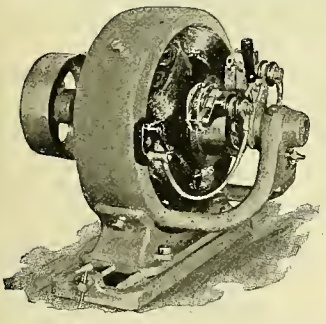
PIONEERS IN ENCLOSED ARC LIGHTING — THE PIONEER — TRADE MARK

150 HOURS.

THE ELECTRIC ARC LIGHT CO.

LOUIS B. MARKS, M.M.E.
CHIEF ELECTRICIAN.

687 & 689 Broadway,
NEW YORK.



WRITE FOR INFORMATION.

DYNAMOS,

15 to 1,000 Lights.

MOTORS,

½ to 50 H. P. ANY VOLTAGE.

Patented Adjustable Dynamos and Motors for Floor, Wall or Ceiling.

The Ahlm-Edwards Electric Co.,
CLEVELAND, OHIO.

GORDON PRIMARY CELL.

For Open and Closed Circuit Work.

The Perfect, Modern, Longest Lived and Most Economical Cell Ever Put on the Market.

In use by the leading cities, railroads, telephone and gas engine companies.

WE CLAIM:—Constant discharge of current without polarization; no local action; no noxious gases or fumes; no acids; least labor for operation; cleanest; not freezing at 28° below zero; economic value 50 per cent. greater than gravity cell, and 30 per cent. greater than best other cell in market. For No. 1 cell, 250 ampere hours; for No. 2 cell, 100 ampere hours; on open circuit, .9 to 1 volt; on closed circuit, .65 to $\frac{7}{10}$ volt. Send for circular and price list.

THE GORDON-BURNHAM BATTERY CO.,

82 to 86 West Broadway, New York City.

General Western Agent. S. F. B. MORSE, Marquette Bldg., Chicago, Ill.

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PARAGON

FAN MOTORS.

CHICAGO EDISON COMPANY,

139 ADAMS STREET, CHICAGO.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF

Cement-Lined Ducts

Engineers and Contractors for Complete Subways.

Address all Correspondence: NEW HAVEN, CONN.

The Connecticut Pipe Manufacturing Company,

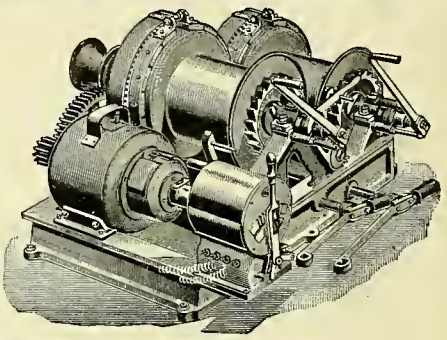
Office and Factory, West Haven, Conn.

Business Established 1865.
Incorporated 1892.

E. H. PHIPPS, President.
GEO. O. RICHARDS, Secretary.
CHARLES WARD, Gen. Mgr.

THE . . .

Storey Motors.



Iron-clad. Completely Closed In. Dust and Moisture Proof. No External Magnetism.

Specially Adapted for Direct Connection to Machinery.

Special Direct Current Motors for All Classes of Work.

THE STOREY MOTOR & TOOL CO.,

MAIN OFFICE AND FACTORY: 212-226 Carter St., Philadelphia, Pa.

CHICAGO OFFICE: Metropolitan Elec. Co., 186-188 Fifth Ave.
BRANCH FACTORY: Hamilton, Canada.

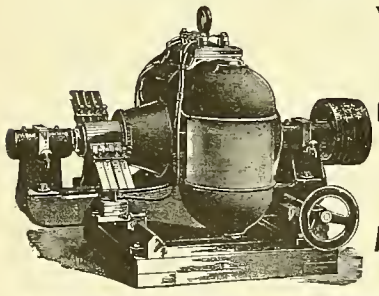
DALLETT

Electric Motors and Generators,

MANUFACTURED BY

THOS. H. DALLETT & CO.,

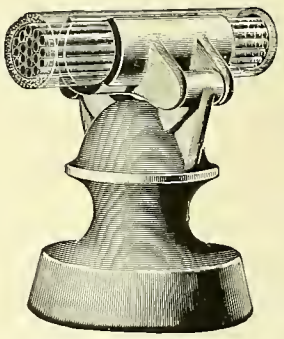
York St. and Sedgley Ave.,
PHILADELPHIA, PA.



Portable Electric Drills, Starting Boxes and Controllers,

Automatic Switches. . . . . .
Flexible Insulated Couplings.

"H. W. J." Toggle Clamp Feed Wire Insulator.



The weight of the wire in the hinged jaws automatically causes the wire to be clamped with a powerful toggle action. Wire may be instantly detached from insulator by lifting it out.

NO BINDING WIRES, NO SCREW CAP, NO DELAYS.

Economical, durable. No abrasion of insulation.

Trolley Line Insulators, Giant Strains, Philadelphia Section Insulators, Etc.
Vulcabeston Parts for Controllers, Motors, Etc.

H.W. JOHNS MANUFACTURING CO.,
240 Randolph St., Chicago, Ill.
NEW YORK. BOSTON. PHILADELPHIA. LONDON.

PARIS

(France) the electrical supply import and export house,

Jacques Ullmann,

16 BOULEVARD ST. DENIS,

Requests illustrated price lists concerning the electrical trade.

REFERENCES: Bradstreet Company, New York; Crocker-Wheeler Electric Company, Ltd., New York.

It has been considered for many years that there was a

Man in the Moon

But a photograph taken on the new forty-inch telescope at the Chicago University discloses the fact that it is not a man, but a

Lundell Fan Motor.

See It?

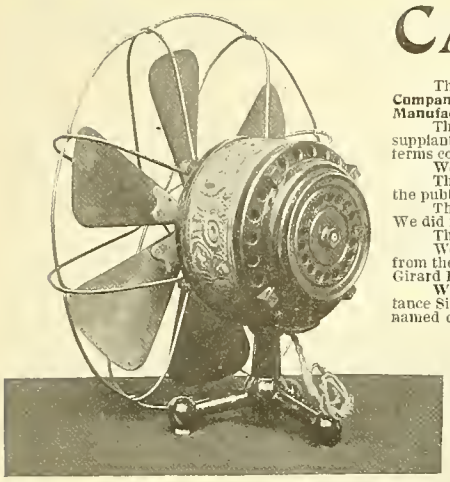
CENTRAL ELECTRIC COMPANY.

173-175 Adams Street,

CHICAGO.

Geo. A. McKinlock, Prest.
Charles E. Brown, Sec'y.
S. R. Frazier, Treas.

OKONITE
IT NEVER DISAPPOINTS



CARD TO THE PUBLIC.

The **General Electric Company, Westinghouse Electric Company, Thomson-Houston Electric Company** and the **Tesla Electric Company** have brought suits against the **Scott & Janney Electric & Manufacturing Company** for "alleged infringements" of their various patents.

This is the **USUAL "BLUFF"** that is brought to bear upon those whose inventions are bound to supplant the inventions of the above named and other large electrical concerns, who cannot at their own terms control such new inventions.

We are manufacturing under **our own patents** and **are not infringing.**

The above named firms are suing us upon a small fan motor as an excuse to get a chance to make the public believe that the state of the art is not history as far as they know it.

They have spent millions of dollars trying to invent apparatus to do certain things. They failed. We did invent it and have had it patented all over the world. **AND IT WORKS.**

They will try by strategy to do what they dare not do openly.

We wish to ask that the dealers and others who have received or will receive threatening letters from the above named concerns, will please send same to our attorneys, Messrs. Alexander & Magill, Girard Building, Philadelphia.

We are in the field to stay and do not propose to be intimidated. The Scott & Janney Long Distance Single Phase Alternating Railway and Power System will supersede the inventions of the above named companies. **AND THEY KNOW IT.**

FULL PROTECTION GUARANTEED TO ALL PURCHASERS OF OUR APPARATUS.

The Scott & Janney Electric and Mfg. Co.,

1707-1709 Filbert Street, PHILADELPHIA.

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Electric Storage Battery Co.
Ohio Storage Battery Co.
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Partrick & Carter Co.

Arc Lamps.
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Bells.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
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Ohio Electric Works.
Partrick & Carter Co.

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Jewell Belting Co.
Main Belting Co.
Peerless Rubber Mfg. Co.
Shultz Belting Co.

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Cloubrock Steam Boiler Co.

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Electrician Publishing Co.

Brushes.
Central Electric Co.
Commercial El. Supply Co.
Holmes Fibre-Graphite Co.
Partridge Carbon Co.

Burglar Alarms.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
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Metropolitan Electric Co.
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New York Ins. Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partridge Carbon Co.
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California Asphalt Co.
Commercial El. Supply Co.
Electric Appliance Co.
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Standard Paint Co.

Conduits.
Armorite Interior Cond. Co.
Central Electric Co.
Commercial El. Supply Co.
Conn. Pipe Mfg Co.
Electric Appliance Co.
Muir & Son, Thos.
National Cond. & Cable Co
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Chicago Edison Co.
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National Electric Co.
Warren Electric Mfg. Co.

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Bain, Foree.
Brush Electric Co.
Bryan & Humphrey.
Bullock Elec. Mfg. Co.
Card Electric Co.
Commercial El. Supply Co.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hodge, Walsh & Loring.
Northern Electl. Mfg. Co.
Peoples Electric Co.
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Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse Elec. & Mfg Co.

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Brixey, W. R.
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Chicago Edison Co.
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General Electric Co.
Metropolitan Electric Co.
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Standard Underground C. Co.
Washburn & Moen Mfg. Co.

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Commercial El. Supply Co.
Electric Appliance Co.

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Automatic Cir. Breaker Co.
Bryant Electric Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Cutter El. & Mfg. Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
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General Elec. Co.
Hart & Hegeman Mfg. Co.
Paiste Co., H. T.
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Peru Elec. Mfg. Co.
Perkins Elec. Switch Mfg. Co.
Reynolds, S. K.
Westinghouse El. & Mfg. Co.

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Chicago Armature Co.
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Eddy Elec. Mfg. Co.
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Siemens & Halske Elec. Co.
Triumph Electric Co.
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Westinghouse El. & Mfg. Co.

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Fuel Economizer Co.

Electric Heaters.
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American El. Heating Corp.
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American El. Meter Co.

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General Electric Co.
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Van Duzen Gas & Gso. En. Co.
Van Horne, Burger & Co.

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Ball Engine Co.

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Scott & Janney El. & Mfg Co.
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Kartavert Mfg. Co.
Vulcanized Fibre Co.

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Fixtures, El. & Comb'n.
Central Electric Co.
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Westinghouse El. &

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Peerless Rubber Mfg. Co.

Gas Lighting, Electric.
Bogart, A. L.

Gears.
Besly & Co., Chas. H.

General Elec. Supplies.
Besly & Co., Chas. H.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Genor & Colburn.
Hodge, Walsh & Loring.
International Elec Co.
Metropolitan Electric Co
Ohio Electric Works.
Paiste Co., H. T.
Partrick & Carter Co.
Peoples Electric Co.
Peru Elec. Mfg. Co.

Globes and Electrical Glassware.
Central Electric Co.
Commercial El. Supply Co.

Gov'nors. Water Wheel.
Lombard Water Wheel Gv. Co.

Graphite Specialties.
Besly & Co., Chas. H.
Dixon Crucible Co., Jos.
Holmes Fibre-Graphite Co.

Induction Coils.
International Elec. Co.
Queen & Co.

Insulators and Insulating Materials.
Brixey, W. R.
Bryant Electric Co.
California Asphalt Co.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Electric Appliance Co.
Elec. Eng. & Supply Co.
Empire China Works.
Hodge, Walsh & Loring.
Johns Mfg. Co., H. W.
Mica Insulator Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Paiste Co., H. T.
Peoples Electric Co.
Peru Elec. Mfg. Co.
Phillips Insulated Wire Co.
Standard Paint Co.
Simplex Electrical Co.
Standard Underground C. Co.

Insulated Wires and Cables—Magnet Wires.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Chicago Edison Co.
Commercial El. Supply Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Underground C. Co.
Washburn & Moen Mfg. Co.

Lamps, Incandescent.
Buckeye Electric Co.
Central Electric Co.
Chicago Edison Co.
Columbia Inc. Lamp Co.
Commercial El. Supply Co.
Electric Appliance Co.
General Electric Co.,
Lynn Incandescent Lp. Co.
Metropolitan Electric Co.
Ohio Electric Works.
Perkins Elec. Switch Mfg. Co.
Sawyer-Man Elec. Co.

Lamp Trim'r's Wagons.
Studebaker Bros. Mfg. Co.

Lightning Arresters.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Westinghouse El. & Mfg. Co.

Magnet Wire.
(See Insulated Wires.)

Mechanical Machinery.
Besly & Co., Chas. H.
Garvin Machine Co, The.
Stilwell-Bierce Smith-Valle

Mica.
Central Electric Co.
Commercial El. Supply Co.
McLaurin & McLaren.
Munsell & Co., Eugene.

Mining Apparatus, Elec.
General Electric Co.
Westinghouse El. & Mfg. Co.

Motors.
Ahlm-Edwards Elec. Co.
American Engine Co.
Belknap Motor Co.
Brush Electric Co
Bullock Elec. Mfg. Co.
Card Electric Co.
Central Electric Co.
Chicago Armature Co.
Commercial El Supply Co.
Dallett & Co, Thos. H.
Diehl Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Metropolitan Electric Co.
Muir & Son, Thos.
Northern Electl. Mfg. Co.
Ohio Electric Works.
Peoples Electric Co.
Scott & Janney El. & Mfg. Co.
Stanley Elec. Mfg. Co.
Storey Motor & Tool Co.
Triumph Electric Co.
Warren Electric Mfg. Co.
Westinghouse El. & Mfg. Co

Packing.
Besly & Co. Chas. H.
Garlock Packing Co.
Johns, H. W., Mfg. Co.
Peerless Rubber Mfg. Co.

Paints.
California Asphalt Co.
Central Electric Co.
Commercial El. Supply Co.
Johns, H. W. Mfg. Co.
Standard Paint Co.

Phosphor Bronze.
Besly & Co., Chas. H.
Phosphor Bronze Sm. Co. Ltd.

Platinum.
Baker & Co.

Poles.
Carley, Ira.
Lindsley Bros.
National Tube Works Co.
Perrizo & Sons.
Pittsburg & L. S. Iron Co.
Sterling & Son, W. C.

Porcelain.
Bryant Electric Co.
Central Electric Co.
Commercial El. Supply Co.
Empire China Works.
Peru Elec. Mfg. Co.

Pulleys.
Rockwood Mfg. Co., The.

Push Buttons.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Partrick & Carter Co.

Refiners.
Swarts Metal Refining Co.

Reflectors.
Muir & Son, Thos.

Regulators.
Belknap Motor Co.

Re-Winding.
Chicago Armature Co.
Chicago Edison Co.
Electrical Exchange, The.
Hodge, Walsh & Loring.
National Electric Co.

Rheostats.
Am. El. Heat. Corporation.
General Electric Co.
Iron Clad Rheostat Co.
Leonard, Ward, Elec. Co.
Muir & Son, Thos.
Westinghouse El. & Mfg. Co

Second-Hand Machin'y.
Chicago Armature Co.
Cornman Co.
Electrical Exchange, The.
National Electric Co.

Shades.
Muir & Son, Thos.

Speaking Tubes.
Electric Appliance Co.
Partrick & Carter Co.

Speed Indicators.
Besly & Co., Chas. H.
Keystone El. Instrument Co.
Queen & Co.
Weston Electrical Inst. Co.

Steam Heating.
Webster & Co., Warren.

Steel Pipe.
National Tube Works Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.
Ohio Storage Battery Co.
Willard El. & Battery Co.

Tapes, Insulating.
American Electrical Works.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Simplex Electrical Co.
Standard Paint Co.
Washburn & Moen Mfg. Co.

Telephones, Telephone Material and Switchboards.
American El. Telephone Co.
Central Electric Co.
Commercial El. Supply Co.
"Elgin" Telephone Co.
Farr Tel. & Cons. Sup. Co.
Lockwood T. & T. Co. of Am.
Metropolitan Electric Co.
Orne Elec. Cons. Co.
Peoples Electric Co.
Standard Tel. & El. Co.
Stromberg-Carlson Tl. M. Co.
Taber & Mayer.
Viaduct Mfg. Co.
Western Tel. Cons. Co.
Whitman & Couch.

Transformers.
Central Electric Co.
Commercial El. Supply Co.
Diamond Elec. Co.
Elec. Eng. & Supply Co.
Ft. Wayne Elec. Corporation
General Electric Co.
Stanley Electric Mfg. Co.
Westinghouse El. & Mfg. Co.

Trolley Cord.
Samson Cordage Wks.

Trucks, Electric Car.
Brill Co, J. G.
General Electric Co.
Westinghouse El. & Mfg. Co

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle.

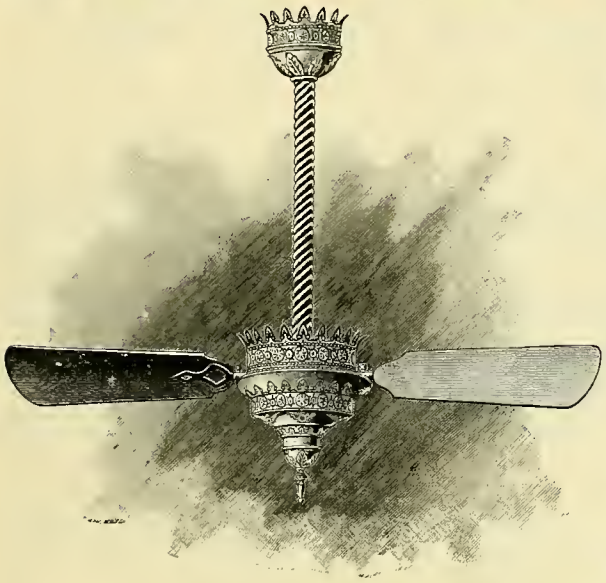
Water Wheels.
Am. Impulse Wheel Co.
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Pelton Water Wheel Co.
Smith Co., S. Morgan.
Stilwell-Bierce Smith-Valle

Wire, Bare.
Besly & Co., Chas. H.
Brixey, W. R.
Central Electric Co.
Commercial El. Supply Co.
Electric Appliance Co.
Okonite Co., The.
Phillips Insulated Wire Co
Standard Underground C Co
Washburn & Moen Mfg. Co.

X Ray Outfits.
Central Electric Co.
Commercial El. Supply Co.
Queen & Co.

For Alphabetical Index of Advertisements See Page III.

DIEHL ELECTRIC FANS.



WOUND FOR ALL CURRENTS, EXCEPT ALTERNATING.

New Designs for this Season.

Ceiling Fans,
Column Fans,
Propeller Fans.

HIGHEST EFFICIENCY. GREATEST DURABILITY.

Our finest designs are ornamented with solid cast brass.

OUR '97 FAN CATALOGUES ARE NOW READY.

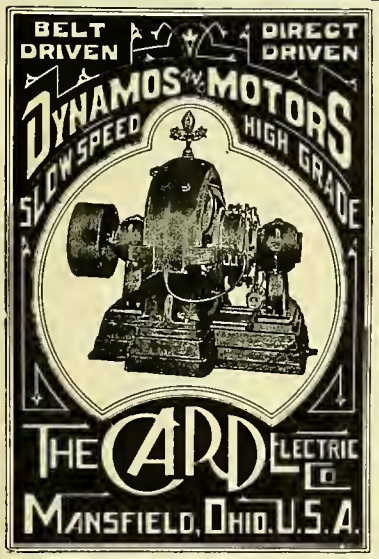
Any of Our Fans Furnished with Four Blades if so Ordered.

SHOW ROOMS:
NEW YORK, 561-563 Broadway. BOSTON, 128-132 Essex Street.
CHICAGO, 192-194 VAN BUREN STREET.

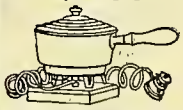
DIEHL MANUFACTURING CO.,

ELIZABETHPORT, N. J.

Agents for Canada: CANADIAN GENERAL ELECTRIC CO., 65-71 Front St. West, Toronto, Ont.



$5.00

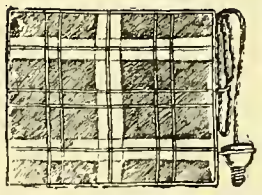


Electric Stew Pan.

$3.00

Electric Curling Iron Heater.

$5.00



Electric Heating Pad.

Some of our goods which connect to lamp sockets, using from ½ to 2 amperes at 110 volts.

AMERICAN ELECTRIC HEATING CORPORATION.

NEW YORK, 39 CORTLANDT STREET. BOSTON, SEARS BUILDING. CHICAGO, MONADNOCK BLOCK.

$4.00

Electric Stove.

$6.00

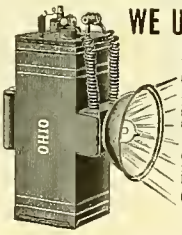
Electric Smoothing Irons.

$7.00

Electric Foot Warmer

"H" BELL
EASY RINGER.
PIVOTED ARMATURE,
DOUBLE ADJUSTMENT.
SEND FOR CATALOGUE.
HUEBEL & MANGER,
MANUFACTURERS,
290 Graham St., Brooklyn, N. Y.

It gives a light that's white and bright,
And two cents is the cost per night.



WE UNDERSELL ALL!

Bicycle Electric Lights	$4.00
Necktie Electric Lights	1.50
Edison Electric Motors	1.00
88 Medical Batteries	3.95
Electric Bells, finest	.25
Dry Batteries, best	.25
$100 Bicycles, best made	39.00
$1.25 Bicycle Bells	.50

Agents Wanted.
Our Bicycle Electric Light is the best thing that ever happened. Catalogue free.
Ohio Electric Works,
13 S. Water St.,
Cleveland, Ohio.

Westinghouse Polyphase Apparatus Supreme.

Generators, Motors, Transformers, for Two-Phase, Three-Phase and C. F. Scott Two-Phase Three-Phase System of Alternating Current Power Transmission.

26,000 H. P. IN OIL-INSULATED TRANSFORMERS CONSTRUCTED.

Potentials from 5,000 to 50,000 Volts. All Apparatus Necessary for 100 Mile Transmission.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

PITTSBURG, PA.

New York, 120 Broadway.
Boston, Exchange Bldg.
Buffalo, N. Y., 8 Erie Co. Bank Bldg.
Charlotte, N. C., 36-38 College St.
Chicago, N. Y. Life Bldg.
Philadelphia, Girard Bldg.
Pittsburg, Westinghouse Bldg.
St. Louis, American Central Bldg.
San Francisco, Mills Bldg.
Syracuse, N. Y., Bastable Bldg.
Tacoma, Wash., 102 S. 10th St.
Atlanta, Ga., Equitable Bldg.

Westinghouse Electric Co., Ltd.,
32 Victoria St., London, S. W., England.
For Canada address
Ahearn & Soper, Ottawa, Ont.

THE OLD, ORIGINAL **SAWYER-MAN LAMP**

Is Still Made and Sold by Us.

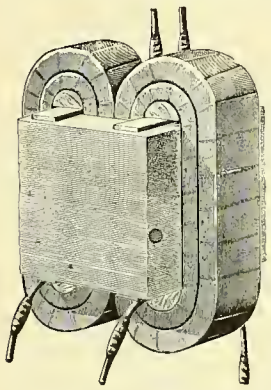
SAWYER-MAN ELECTRIC CO.,

125 Robinson St., Allegheny City, Pa.

WESTERN ELECTRIC CO.

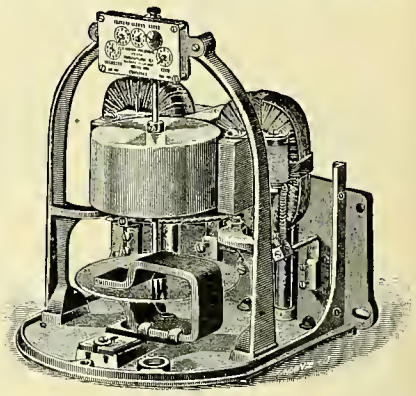
CHICAGO. **SUPPLIES**

Transformers (SCHEEFFER'S IMPROVED) **Wattmeters.**



No Brushes,
No Commutator,
No Moving Wire,
Simplicity,
Durability,
Reliability,
Accuracy,
Even to a 6 c. p. Light.

Double Primary Coils,
Double Secondary Coils,
Good Ventilation,
Light Weight,
High Efficiency,
Good Regulation,
Small Iron Loss.
Convenient to Install.



DIAMOND ELECTRIC CO.,

Manufacturers,

Office: 1202 Fisher Bldg., CHICAGO, ILL.

Factory: PEORIA, ILL.

REWIRED WITH RAVEN WHITE CORE WIRE

—OFFICE—
The Ferris Wheel Co.
9131 THE ROOKERY.

CHICAGO, April 30, 1896.

NEW YORK INSULATED WIRE CO.,
320 Dearborn St., Chicago, Ill.

GENTLEMEN:—After carefully considering the merits of the various brands of wire upon the market, we have decided to use your "Raven White Core" exclusively for rewiring the Ferris Wheel.

As you are aware, the wire upon the wheel is very much exposed and the test will no doubt be a most severe one.

Yours very truly
THE FERRIS WHEEL CO.
By L. V. Rice, Mgr.

GRIMSHAW WHITE CORE. Used exclusively for all Incandescent Lighting at World's Columbian Exposition.

RAVEN WHITE CORE. Used in some of the largest buildings in the United States.

COMPETITION LINE WIRE. Used by some of the largest Central Stations and Fire and Police Departments in the U. S.

GRIMSHAW TAPES, COMPETITION TAPES AND SPLICING COMPOUNDS.

New York Insulated Wire Company,

MAIN OFFICE: 13-17 Cortlandt St., New York.
BRANCHES: CHICAGO: 320 Dearborn St. BOSTON: 134 Congress St. SAN FRANCISCO. 115 New Montgomery St.

The Tuerk Alternating Current Ceiling Fan.

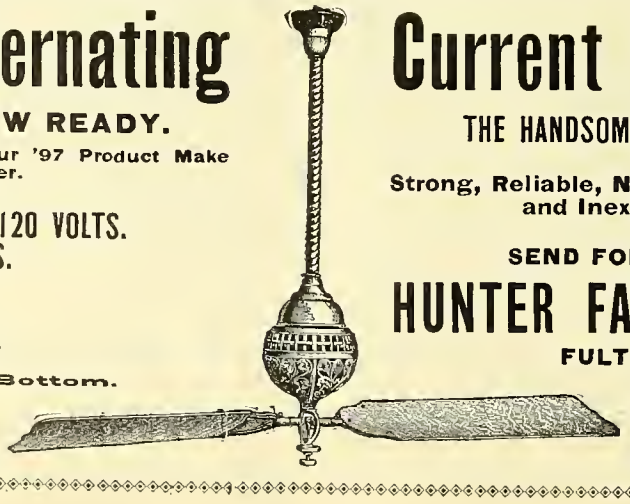
1897 PATTERNS NOW READY.

Some New Features Embodied in Our '97 Product Make It Better than Ever.

MADE FOR FROM 50 TO 120 VOLTS.
60, 125 AND 140 CYCLES.

SPECIAL FEATURES:
High Economy.
Self-Oiling Bearings.
Adjustable Blades.
Starting Switch at Bottom.

Five different styles of finish—Bronze, Bower-Barff, Ivory and Gold, Nickel, Polished Brass.



THE HANDSOMEST FAN ON THE MARKET.

Strong, Reliable, Noiseless, Durable, Ornamental and Inexpensive to Operate.

SEND FOR 1897 CATALOGUE.

HUNTER FAN & MOTOR CO.,

FULTON, NEW YORK.

E. B. LATHAM & CO., General Selling Agents, 136 Liberty Street, New York, U. S. A.

"THE ELECTRA"

ELECTRA *TRADE MARK*

HIGHEST GRADE NUERNBERG CARBONS.

FOR DIRECT CURRENT ARC LAMPS. FOR ALTERNATING CURRENT ARC LAMPS.

SEND FOR LATEST PRICE LIST TO

HUGO REISINGER, NO. 38 BEAVER STREET, NEW YORK. SOLE IMPORTER FOR THE UNITED STATES AND CANADA.

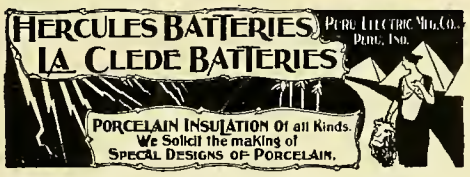
WESTERN ELECTRIC CO.

SUNBEAM LAMPS NEW YORK.

STORAGE BATTERIES.

NON-INFRINGING, DURABLE, INEXPENSIVE.

OHIO STORAGE BATTERY CO., - 59 Wade Building, CLEVELAND. OHIO.



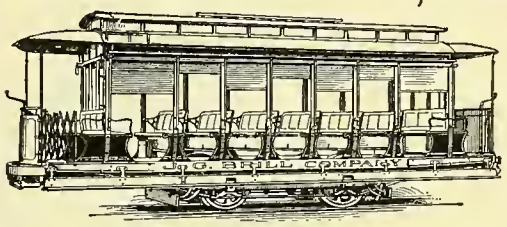
NEW EDITION,

CROSBY & BELL'S ELECTRIC RAILWAY,

JUST OUT. PRICE $2.50. SEND FOR IT.

ELECTRICIAN PUBLISHING CO., 510 Marquette Building, CHICAGO.

J. G. BRILL COMPANY, PHILADELPHIA,



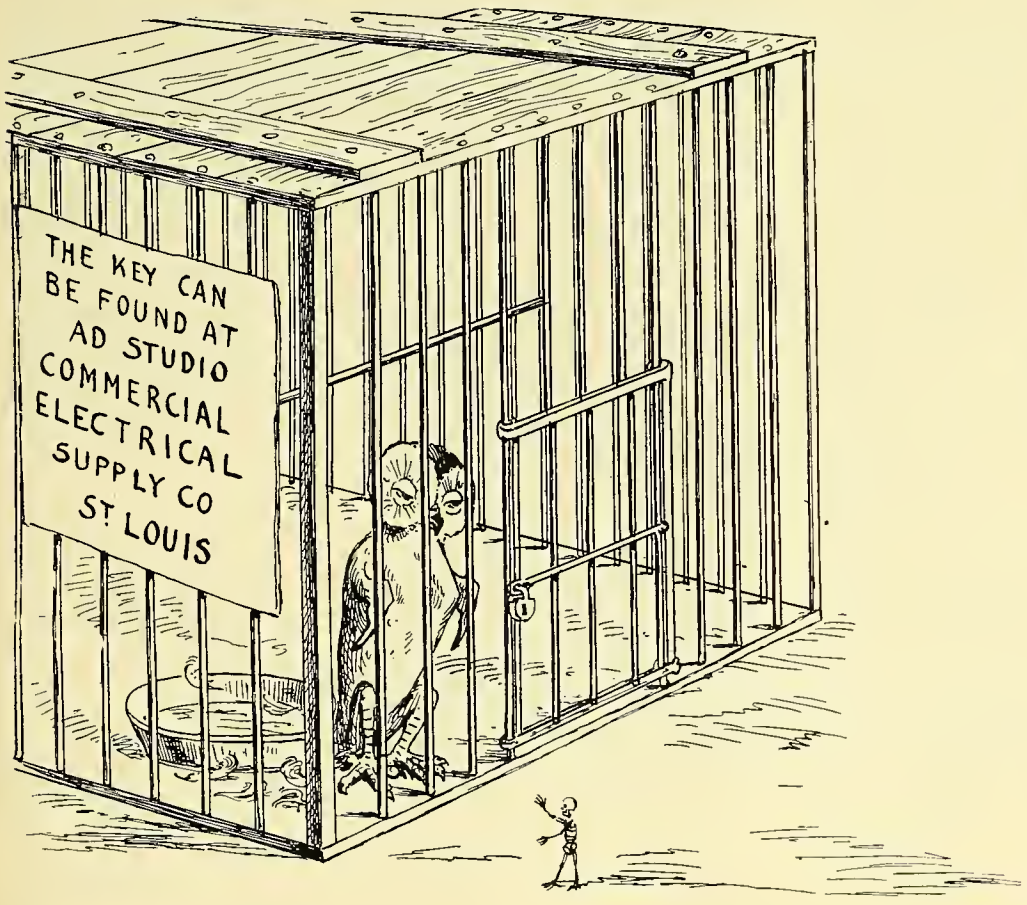
MANUFACTURERS OF

Electric Cars and Trucks, Solid Forged Frame Trucks, Trucks for 4-Wheel Cars.

PIVOTAL TRUCKS FOR STEAM AND ELECTRIC SERVICE.

The PERFECT TRUCK, our "No. 27," is safer, easier on rails, easier for passengers and imparts less motion to the car body than any truck ever made.

WE CAN SUBSTANTIATE OUR CLAIMS.



A CONVENTION ECHO!

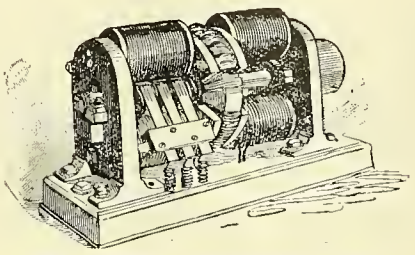
You crazy "Old Jay!" I told you to keep away from those New York fellows at Niagara—but you wouldn't—now look at you! The boss 's mad as a hornet because you got caught in the "rapids" and lost all your feathers!—But say! You ought to see that new **Commercial Electrical Supply Co.'s Catalogue**—it's a daisy! Just hoot, "Old Man," in a week or so, and I'll show you one!

THE BRUSH ELECTRIC COMPANY.

BRUSH

THE BRUSH ELECTRIC COMPANY.

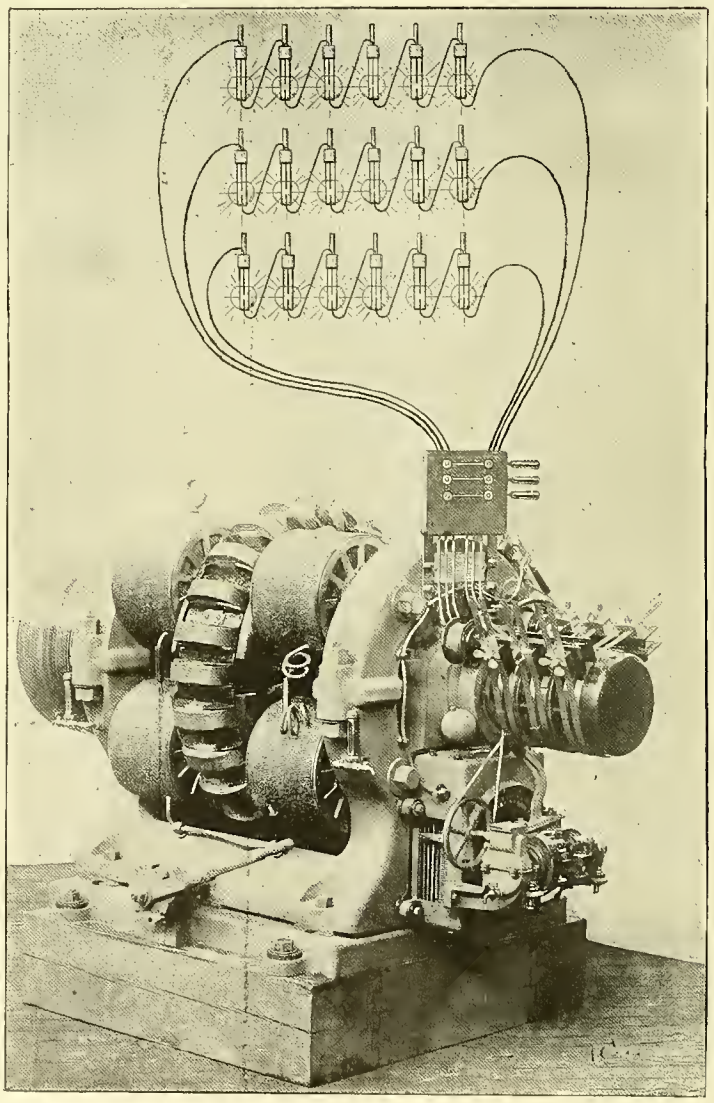
Brush apparatus has been on the market for 20 years. A majority of customers order supply parts direct from us. Many do not. We want this trade and are reducing our prices in order to secure it. Ask for quotations and send orders to the nearest Sales Office.



FIRST BRUSH ARC DYNAMO—1877.

SALES OFFICES:
Schenectady, N. Y.
Cleveland, Ohio.
Boston, Mass., 180 Summer Street.
New York, N. Y., 44 Broad Street.
Philadelphia, Pa., 509 Arch Street.
Cincinnati, Ohio, 420 West Fourth Street.
Chicago, Ill., Monadnock Building.
St. Louis, Mo., Wainwright Building.
Atlanta, Ga., Equitable Building.
Denver, Colo., Kittredge Building.
San Francisco, Cal., 15 First Street.
Toronto, Ont., Canadian General Electric Co., Ltd.
Pittsburg, Pa., Carnegie Building.

Many stations have exchanged all their small units for large Brush arc dynamos. Among them are the Brooklyn-Citizens with 3000 lights capacity. Brooklyn-Municipal 800, Newark 3000, Cleveland 1800, Philadelphia Brush 1500, Philadelphia-Northern 1300, Buffalo 1500, Worcester 1400, Toronto 900, Quebec 625, Harrisburg 750, Erie 750, Albany 500, Troy 500, Paterson 500, City of Chicago 400, John Wanamaker 625, Carnegie Steel Co. 500.



BRUSH MULTI-CIRCUIT 125 LIGHT ARC DYNAMO—1897.

Over 40,000 lights capacity in large Brush arc dynamos sold. A large proportion of them using Multi-Circuit Dynamos.

The newly designed Brush dynamos have the following capacities; 55, 80, 100, 125, 240, 300, 2000 candle-power lights, 45, 85, 120, 160, 1200 candle-power lights.

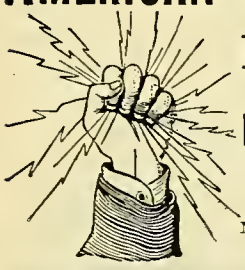
Brush arc lamps were first used in 1877. More of them being sold to-day than ever before.

Two or more separate circuits run direct from one dynamo with any distribution of load on the different circuits. The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belts, shafting, pulleys, attendance.

EUGENE F. PHILLIPS, Prest. F. N. PHILLIPS, Treas. W. H. SAWYER, Secy.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

CABLES FOR AERIAL AND UNDERGROUND USE.

NEW YORK STORE, P. C. Ackerman, 10 Cortlandt St.
CHICAGO STORE, F. E. Donohoe, 241 Madison St.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

THE ONLY

WATER-WHEEL GOVERNOR

THAT GOVERNS.

WATERVILLE & FAIRFIELD RAILWAY & LIGHT CO.,
WATERVILLE, ME., Jan. 18, 1896.

Lombard Water-Wheel Governor Co., Boston, Mass.

GENTLEMEN:—In regard to your Type C governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we are frank to admit that the machine does its work admirably. We have no hesitancy in recommending it to those in want of a governor.

(Signed)
I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co.

LOMBARD WATER-WHEEL GOVERNOR CO.,

61 Hampshire St., BOSTON, MASS.

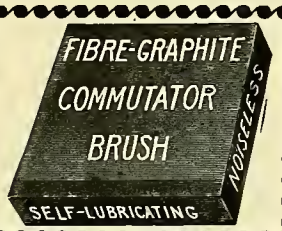
No Sparking Under Varying Load,
No Wear on the Commutator.

90% PURE GRAPHITE.

Holmes Fibre-Graphite Mfg. Co.,

Station Z, Philadelphia.

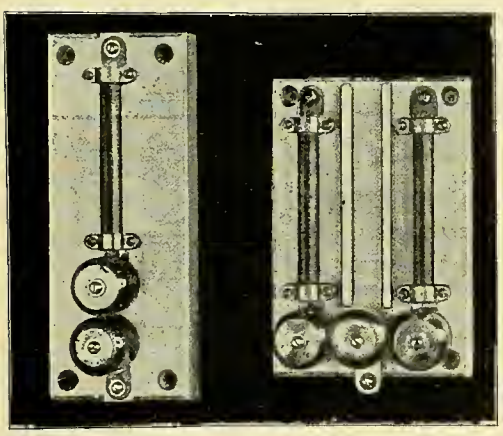
WRITE FOR PRICE LIST.



GRAPHITE FOR RESISTANCE...

Made in almost any form required and of 1 ohm or 1,000,000 ohms as desired. We also make graphite boxes and crucibles resisting heats of 4,000 degrees. . . . . .

JOS. DIXON CRUCIBLE CO., - - Jersey City, N. J.



SINGLE POLE 1,000 VOLTS. DOUBLE POLE 1,000 VOLTS.

Wirt Short-Gap Lightning Arresters

For Alternating Current Circuits of any Potential.

Will take the discharge when large gap arresters fail to protect. Small current only at time of discharge. No moving parts.

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Each proposal must be accompanied by a certified check for two per cent. of the amount of the bid, payable to the order of James E. Heg, President, to be forfeited to the State of Wisconsin in case the bidder or bidders chosen fail to enter into a contract with the Board and furnish a satisfactory bond for the proper execution of the same within ten days after the acceptance of their proposals.

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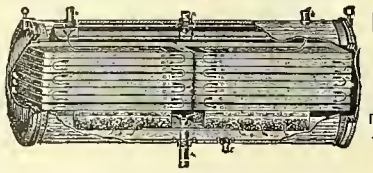

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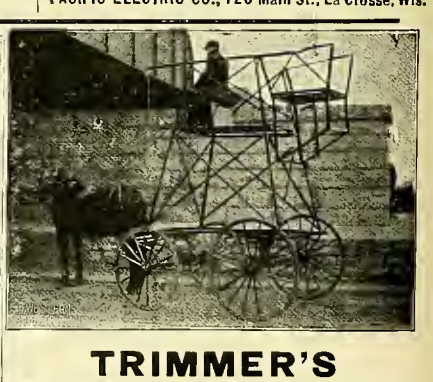

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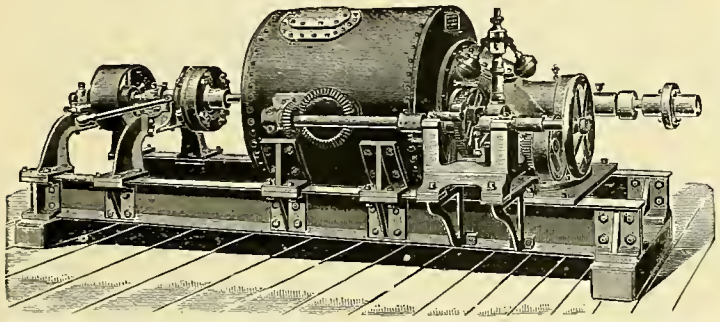

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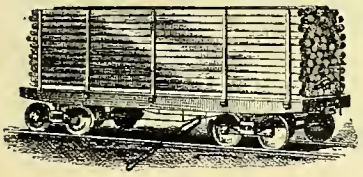

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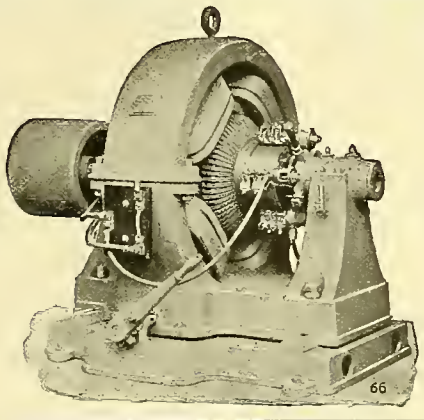

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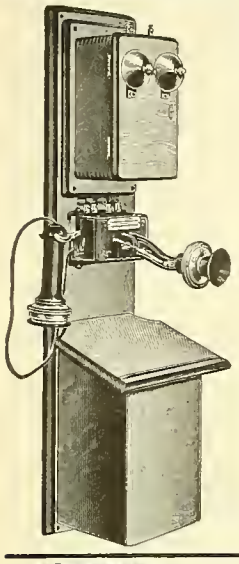

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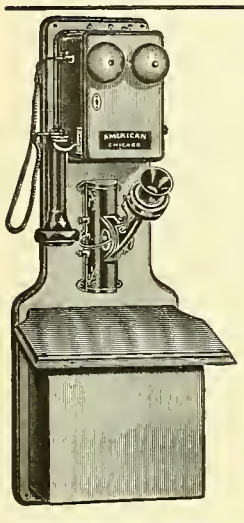

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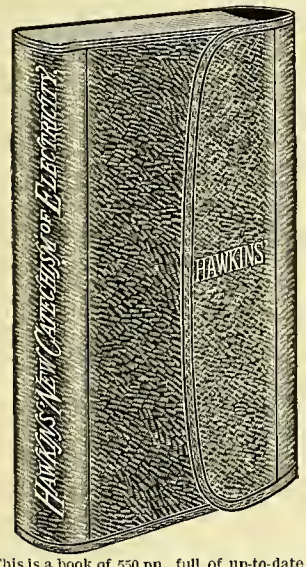

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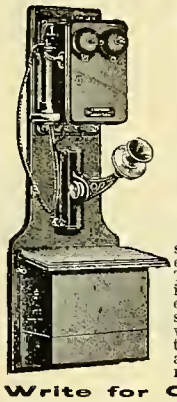

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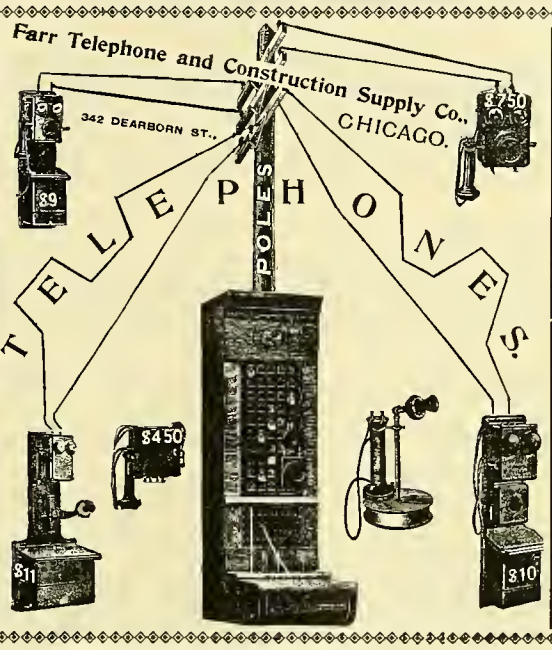

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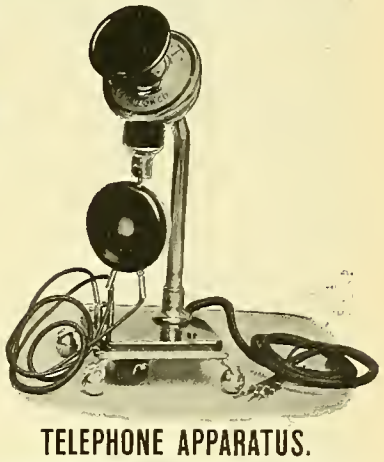

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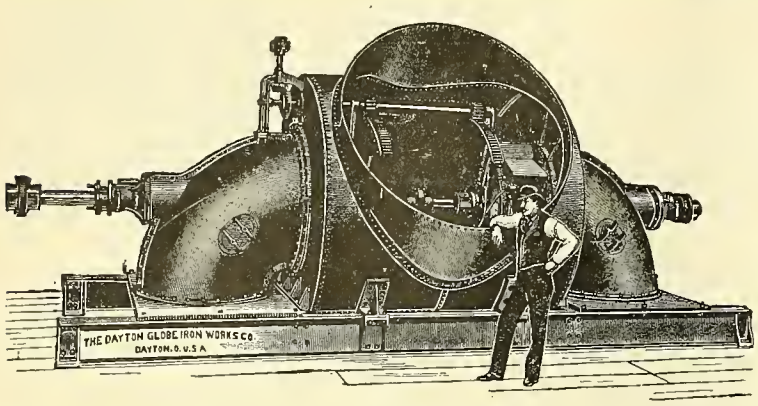

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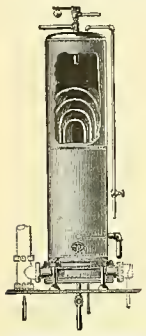

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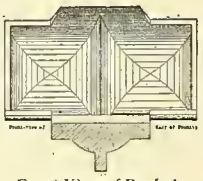

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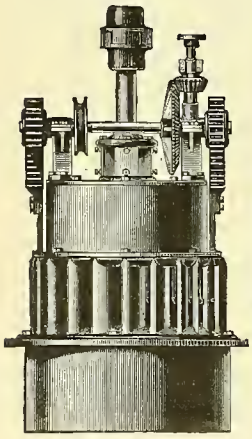

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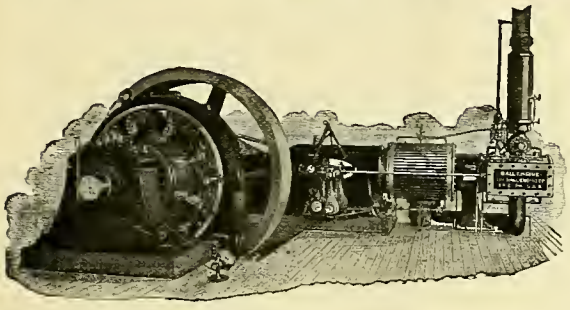

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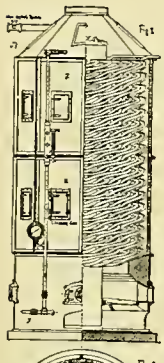

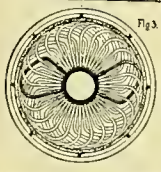

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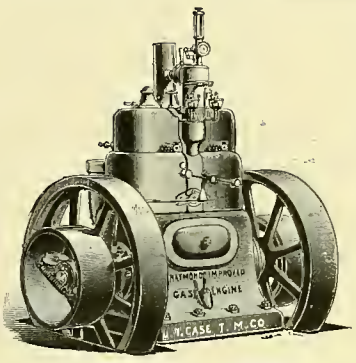

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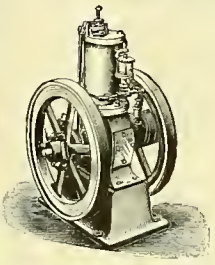

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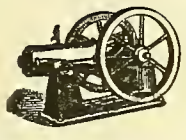

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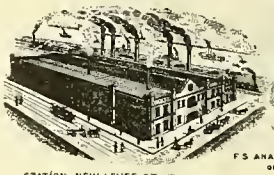

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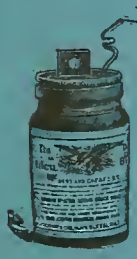

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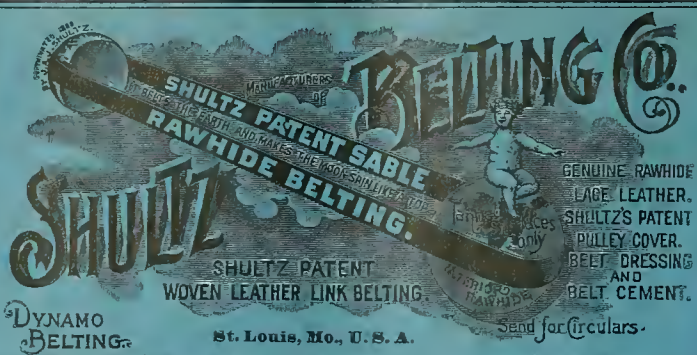

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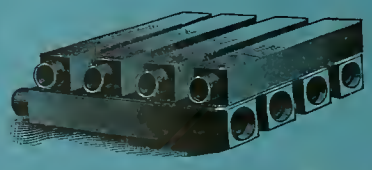

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